



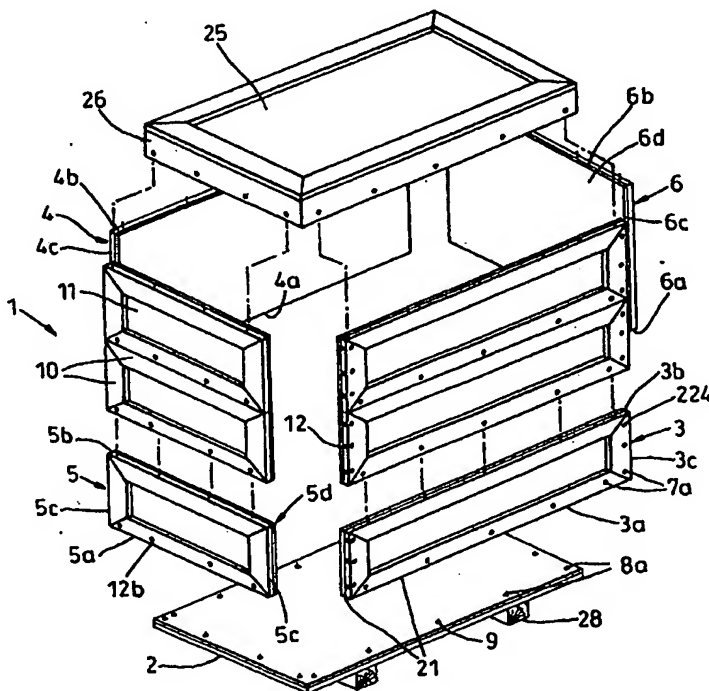
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: MODULAR BOX

## (57) Abstract

The invention provides a box (1) comprising a base panel (2), one or more pairs of side panels (3, 4) and one or more pairs of end panels (5, 6). Each of the panels (3, 4, 5, 6) is fastened to its neighbouring panels by co-operating fastening means comprising a retaining means such as a collar (8a) inserted in one panel and a two part catch (7a) inserted in an elongate hole (12) in an adjacent panel or a cam means (7b) inserted in a recess in one panel and a dowel means (8b) fitted into the edge of the adjacent panel. The two part catch (7a) or the cam means (7b) are operated by movement means (204, 22) to draw the two parts of the co-operating fastening means together to bring the adjacent panels into close engagement and to retain the panels together.



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## MODULAR BOX

The invention relates to boxes that are constructed from a plurality of panels and particularly, though not exclusively, to boxes in which the  
5 panels are fastened together by releasable fastening means.

Boxes or crates may be made from a plurality of panels fastened together by various means such as screws, nails or adhesives. The panels can be made of a variety of materials but are commonly formed from softwood  
10 battens with a plywood insert.

An ever-increasing problem in all industries is the production of waste. Companies may be penalised for producing too much packaging waste and the cost of waste disposal can be significant. There is therefore a need  
15 for packaging that is reusable and recyclable to a greater extent than with presently available packaging options.

An object of the invention is to provide a box which is modular in that the panels from which the box is comprised can be repaired or replaced if  
20 damaged. A further object of the invention is to provide a box that can be assembled from a plurality of panels in different sizes or shapes to suit different requirements.

In a first embodiment, the invention provides a box comprising a plurality  
25 of panels and co-operating fastening means for fastening adjacent panels together, wherein the fastening means comprises:

retaining means in a first panel;

a catch member inserted in an elongate hole in a second panel, the catch member comprising an engagement portion having movable anchor

means and an operating portion having operating means for moving the anchor means; and

means to move the engagement portion and the operating portion along the elongate hole.

5

Preferably the panels are made of wood but they may alternatively be made of any suitable material into which the catch means and retaining means may be fitted. Advantageously the panels are standard box panels comprising softwood battens with a plywood insert. Preferably the parts  
10 of the panels are fastened together by screws, to ensure improved repairability of the panels, but alternatively they may be fastened together by nails or other suitable means.

Preferably the retaining means comprises a collar inserted in a bore in the  
15 first panel. Alternatively the retaining means may be integral with the first panel, for example the retaining means may be a collar integrally moulded within a bore integrally moulded in a panel of plastics material.

Preferably the operating portion comprises a plunger portion having  
20 plunger means. Preferably the second panel further includes an access hole extending at right angles to, and into, the elongate hole. Preferably the movement means moves the engagement portion and the plunger portion along the elongate hole towards and into the collar to engage the connector and moves the engagement portion and the plunger portion  
25 along the elongate hole away from the collar and back into the elongate hole to disengage the connector. Preferably, as the engagement portion and the plunger portion are moved along the elongate hole to engage with the collar, the anchor means is moved into an engagement position relative to the collar. At this position, the engagement portion is preferably

disengaged from the moving means while the plunger portion continues to be moved by the moving means with respect to the engagement portion such that the plunger means is advanced between the anchor means within the collar to move the anchor means into engagement with the collar.

5

The collar is advantageously inserted in a bore in the panel. The collar preferably has a self-tapping thread for insertion and fixing within the bore. Preferably the collar has an angled face for co-operation with the anchor means. The collar may advantageously be machined or die cast metal. It must be sufficiently strong and held within the bore with sufficient strength to withstand forces on the anchor portions of the connector which will tend to pull the two panels apart. Advantageously the collar comprises a cylindrical collar with a self-tapping thread on the outer surface of the cylinder and a smooth bore on the inside surface of the cylinder, the smooth bore extending to an angled face on the interior of the bore or on the inside end of the cylinder. Advantageously for a collar having an angled face on the interior of the bore of the cylinder, the bore in the panel is substantially the same depth as the collar. Alternatively, for a collar having an angled face on the inside end of the cylinder, the bore in the panel has a greater depth than the length of the collar.

The catch member is inserted in the elongate hole which preferably extends from the edge of the panel or a batten fastened to the panel and the access hole extends to the elongate hole from the face of the panel or batten. In an alternative arrangement, the catch member may be inserted within a sleeve in the elongate hole.

The engagement portion and the plunger portion of the catch portion comprise two complimentary portions that are arranged in conjunction with one another. The engagement portion preferably comprises a body portion attached to the anchoring means. The plunger portion preferably  
5 comprises a body portion attached to the plunger means. Preferably the plunger means is arranged within the anchor means and the respective body portions are arranged adjacent one another.

Preferably the anchor means comprises a two fingered collet. Preferably  
10 the end faces of the fingers are angled to co-operate with the angled face of the collar. The fingers are resilient such that the movement of the plunger through the anchor means causes the fingers to be forced outward and retraction of the plunger through the anchor means allows the anchor means to return to their original position. Advantageously the fingers are  
15 formed with notches on their inner surface for engagement with corresponding ridges on the plunger means to indicate when the anchor means is in engagement with the collar. Alternatively the notches may be formed on the plunger means and the ridges may be formed on the fingers. The co-operating notches and ridges also advantageously serve  
20 to retain the connector in the engaged position. The "click" as the ridge engages with the notch indicates to an operator that the connector is in the operable position. Additionally, some force is required to disengage the connector, thus reducing the risk of inadvertent disengagement. Advantageously a further set of co-operating notches is provided to serve  
25 as an engagement means with the ridges when the catch is retracted to withdraw the anchor means with the plunger means.

Preferably the elongate hole is dimensioned such that the catch means is within the panel when it is fully retracted. Advantageously the catch

means is formed with a protruding lug at its inner end to ensure correct alignment of the two catch components, anchor and plunger, during installation.

5 Preferably the plunger portion comprises a substantially cylindrical plunger that extends between the anchor means. The body portion of the anchor means includes a disengagement portion such that, as the catch means is advanced by the movement means, the anchor means moves into position relative to the collar, the movement means then disengages from  
10 the anchor means but remains in engagement with the plunger means so that the plunger is advanced further between the fingers of the anchor portion, forcing the fingers apart and into engagement with the collar to hold the two panels together.

15 The catch means is advantageously formed of injection moulded plastics, advantageously a polycarbonate material. Alternatively, the engagement portion may be formed of a polycarbonate material and the plunger portion may be formed of an acetal material, though any suitable materials may be used.

20

Preferably the body portion of the anchor means comprises teeth for engagement with the movement means. Preferably the body portion of the plunger means comprises teeth for engagement with the movement means. Preferably the respective body portions are formed as  
25 complimentary sections, each being half the thickness of the catch means and each having complimentary sets of teeth for engagement by the movement means, such that the movement means engages with both sets of teeth to move both the engagement portion and the plunger portion.

Preferably the movement means comprises a key having a splined shaft which is inserted through the access hole. Preferably the shaft is held in position within the access hole and is operated by a key means. Preferably the shaft passes right through both body portions and engages  
5 with a co-operating hole in the panel to the rear side of the elongate hole. This holds the shaft in position relative to the catch means. Advantageously an insert sleeve is mounted in the co-operating hole. Preferably the insert sleeve has a "click" fitting to indicate to an operator when the splined shaft is in engagement and/or to prevent inadvertent  
10 disengagement of the splined shaft.

When the shaft is rotated, the spline co-operates with the teeth in the body portions to move the catch means. When the spline reaches the end of the teeth section on the anchor portion, it moves into a free wheel  
15 position. The anchor portion thus does not move any further but continued rotation of the shaft causes the plunger portion to be moved further with respect to the anchor portion. This forces the plunger means between the fingers, moving them apart and into engagement with the collar.

20 To release the catch, the shaft is rotated in the other direction, thus retracting the plunger portion which allows the fingers of the anchor means to return to the disengaged position. As the plunger portion is moved back, the anchor portion is pulled back with it, bringing the spline  
25 back into engagement with the teeth on the anchor portion and thus retracting both portions of the catch back into the elongate hole.

Because it is advantageous for a user to be able to operate the connector in a known direction, it is preferable for the elongate hole and the catch to



co-operate in only one orientation. An advantageous arrangement for ensuring this is for the elongate hole to have a modified or non-circular cross-section and for the catch to have a cross-sectional shape to co-operate with the cross-section of the hole. An example of this would be  
5 for the hole to have a "D" shaped cross-section and for the catch to have one side with a flat face. An advantageous alternative arrangement is for the elongate hole to further comprise a small diameter hole with its centre point on the circumference of the elongate hole and for the catch to include a small locating lug integrally formed into one part of either the  
10 plunger or anchor portions. In a further alternative arrangement, an insert sleeve may be inserted in the elongate hole, the insert sleeve having an internal cross-section adapted to allow insertion of the catch member in a desired orientation.

15 Advantageously the fingers form a split cylinder surrounding the plunger.

Advantageously the panels are made in standard sizes and different size boxes can be made by using different numbers and arrangements of the panels. Preferably one of the panels of the box comprises a base panel  
20 and at least three, but preferably four or multiples of four, of the panels comprise side panels. Preferably the fastening means on the base panel comprises the retaining means, preferably a collar, inserted in the upward face of the panel, and the fastening means on the lower edge of the side panels comprises the catch member with the elongate hole extending in an  
25 upwardly vertical direction from the lower edge of the side panels.

Advantageously one of the panels of the box comprises a top panel or lid. Preferably the lid comprises one or more side pieces that extend in a downwardly vertical direction, with respect to the normal orientation of

the box, and the fastening means are inserted in the side piece. Advantageously the fastening means in the side pieces comprise the catch member and the retaining means are inserted in the top edge of the adjacent side panels.

5

Advantageously the side pieces of the lid extend sufficiently to enable the lid to cover the panels of the box when the box is dismantled and the lid and base panel can be fastened together with the side panels retained between them.

10

In one embodiment, the panel comprises battens of, for example, softwood, and a sheet of, for example, plywood. The elongate hole extends into the battens from the edge of the panel or into the face of the panel.

15

If any one panel is not intended for attachment to another panel the fastening means may be removed or not included, as desired. However, the arrangement of the catch such that it can be retracted fully within the panel when not in use means that the catches that are not in use can be  
20 arranged so as not to interfere with other panels or be at risk from damage.

Advantageously the side panels comprise either a "female" panel or a "male" panel. Thus, each side edge of each of the side panels will have  
25 the same fastening means such that a "female" panel will have retaining means at each side edge for fastening to the catch member of two adjacent "male" panels.

Advantageously the panels are manufactured to have access to the catch member to move the anchor means from one of either the interior or the exterior of the box when assembled.

- 5 In a second embodiment, the invention provides a box comprising a plurality of panels and a plurality of connecting posts, and co-operating fastening means for fastening adjacent panels together or to fasten a panel to a connecting post, wherein the fastening means comprises:
- retaining means in a first panel or a connecting post;
  - 10 a catch member inserted in an elongate hole in a second panel or a connecting post, the catch member comprising an engagement portion having movable anchor means and an operating portion having operating means for moving the anchor means; and
  - means to move the engagement portion and the operating portion
  - 15 along the elongate hole.

Preferably the retaining means are mounted on the connecting posts.

- For assembly of two panels at right angles together, the panels are each
- 20 fastened to a connecting post in the form of a corner post having two faces at right angles to each other and having retaining means such as collars mounted on each of the said faces into which is moved the anchor means of the catch member mounted on each of the two panels.

- 25 For assembly of two panels at 180° to each other, for example in an extended box, the panels are each fastened to a connecting post in the form of an intermediate post having two faces opposed to each other and having collars mounted on each of the said faces. The anchor means of

the catch members mounted on each of the two panels are moved to engage with the collars on each of the faces.

Advantageously different length connecting posts are provided for boxes  
5 of more than one panel in height. Advantageously the connecting posts extend the full height of the number of panels used and the panels are fastened to the connecting posts at their sides and to a vertically adjacent panel at one or both of the upper and lower edges. Alternatively a panel may be fastened to a vertically adjacent panel by means of a connecting  
10 post. In a further alternative arrangement, a plurality of connecting posts of the height of a single panel may be used to assemble a box of more than one panel in height, the vertically adjacent connecting posts being fastened together by suitable means.

15 A box in accordance with the second embodiment of the invention comprising the connecting posts has the advantage that the user can select whether to have interior or exterior access to the fastening means depending on the particular requirements of the intended use of the box. The user may select the orientation of the panels as required, including  
20 having different orientations of panels in one box. An advantage of this is that the preferred entry direction for a person opening the box can be pre-selected.

The box of the invention in either embodiment can be simply assembled  
25 and dismantled by engagement and release of the co-operating fastening means. The arrangement of the invention enables any panel or combination of panels to be removed selectively without the need for full disassembly of the box.

The invention further provides a tote bin in accordance with the first or second embodiments of the invention. Preferably the tote bin further comprises fastening means for fastening a first tote bin to a second tote bin, the fastening means comprising retaining means in a first tote bin, a  
5 catch member inserted in an elongate hole in a second tote bin, the catch member comprising an engagement portion having movable anchor means and an operating portion having operating means for moving the anchor means, and means to move the engagement portion and the operating portion along the elongate hole, for fastening the top of the first tote bin to  
10 the bottom of the second tote bin.

Preferably the fastening means comprises retaining means that may be inserted in the upper edge of a first tote bin when the tote bin is to be stacked with a second tote bin and catch members inserted in elongate  
15 holes at the lower edges of the side panels of the second tote bin. Thus, when the tote bins are to be stacked, the second tote bin is arranged on top of the first tote bin, the anchor means of the catch members are moved into the retaining means and the connector is operated to draw the two bins together and hold them in stable relationship with one another.

20

The tote bin preferably further comprises carrying means such as handles or hand slots. Advantageously one end of the tote bin comprises a cut away section. Alternatively the tote bin is assembled with one end omitted. Thus, when stacked, a plurality of tote bins can be used to form  
25 a simple shelving system. The tote bin can comprise a base with co-operating fastening means for attachment to the side panels or may comprise a simple drop-in base.

Advantageously a plurality of tote bins or boxes according to the invention may be stacked on a pallet using further co-operating fastening means. Advantageously the pallet is provided with a plurality of retaining means such as collars inserted therein for co-operation with catch members at the  
5 lower edges of the box or tote bin. Alternatively the fastening means may comprise catch members inserted at the edges of the pallet to co-operate with retaining means such as collars at the lower edges of the box or tote bin.

10 Advantageously a box according to the invention may also be provided with fork lift runners attached to the base of the box by co-operating fastening means.

In a further arrangement, a box according to the invention may further  
15 comprise one or more internal fittings attached to the box by co-operating fastening means. Such internal fittings may be in the form of a plurality of bars to form a fitment to hold a piece of equipment securely within the box for transportation.

20 In a third embodiment, the invention provides a box comprising a plurality of panels and co-operating fastening means for fastening adjacent panels together, wherein the fastening means comprises:

cam means having a cam track for insertion into one face of a first panel; and

25 dowel means having a first end for mounting on a second panel and a second end for co-operating with the cam track;  
and wherein:

the first panel comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the panel to the

cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted on the second panel is inserted into the hole in the edge of the first panel until the second end of the dowel means engages the cam track of the cam means and rotation of  
5 the cam means causes the second end of the dowel means to be drawn further into the hole in the first panel to bring the first and second panels into close engagement and to retain the panels together.

Preferably the panels are made of wood but they may alternatively be  
10 made of any suitable material into which the cam means and dowel means may be fitted. Advantageously the panels are standard box panels comprising softwood battens with a plywood insert. Preferably the panels are fastened together by screws, to ensure improved repairability of the panels, but alternatively they may be fastened together by nails or other  
15 suitable means.

The dowel means may be made of metal, nylon or any suitable material. Advantageously the first end of the dowel means has a screw thread. The dowel may be mounted on the face of the second panel or on an edge  
20 thereof. Preferably an insert of, for example, nylon or plastics material, is mounted in the face or edge of the second panel and the dowel means is screwed into the insert. Alternatively the dowel means may be inserted directly into the second panel. Advantageously the second end of the dowel is formed with a groove for co-operating engagement with the cam  
25 track.

The cam means may be made of metal, nylon or any suitable material. The cam means is inserted into a recess formed in the face of the first panel. The cam means may be inserted directly into the recess in the

panel or alternatively may be mounted into a nylon or plastics cam support insert. The cam support insert may be positioned in the recess and then the cam means mounted into the insert or, alternatively, the cam means and the cam support insert may be made as a combination and inserted  
5 into the recess together. The positioning of the recess must be determined accurately to enable the dowel to fit correctly into the cam track and the panels to be brought into close proximity on turning of the cam means to tighten the fitting. The cam means is rotatable in the recess such that the cam track moves relatively to the second end of the dowel to  
10 pull the dowel inwardly to fasten the adjacent panels together. The fastening means may also be released by rotating the cam means in the opposite direction to move the cam track relative to the dowel such that the second end of the dowel can be released from the cam track such that the panels can then be separated.

15 Advantageously the cam means may be rotated by a screwdriver, allen key or similar tool. In a preferred embodiment however, the cam means is formed with a selected lock formation such that it can only be rotated by means of a key that corresponds to the selected lock formation. This  
20 improves the security of the box against unauthorised opening or removal of panels. The selected lock formation may comprise, for example, separate engaging elements or a solid block for engagement with a corresponding key.

25 The box of the invention can be simply assembled and dismantled by engagement and release of the co-operating fastening means.

Advantageously the panels are made in standard sizes and different size boxes can be made by using different numbers and arrangements of the



panels. Preferably one of the panels of the box comprises a base panel and at least three, but preferably four or multiples of four, of the panels comprise side panels. Preferably the fastening means on the base panel comprises dowel means inserted in the upward face of the panel to extend  
5 in an upwardly vertical direction, with respect to the normal orientation of the box, and the fastening means on the lower edge of the side panels comprises cam means with a hole extending in an upwardly vertical direction from the lower edge of the side panels.

10 Advantageously one of the panels of the box comprises a top panel or lid. Preferably the lid comprises one or more side pieces that extend in a downwardly vertical direction, with respect to the normal orientation of the box, and the fastening means are inserted in the side piece. Advantageously the fastening means in the side pieces comprise the cam  
15 means and the dowel means are inserted in the top edge of the adjacent side panels to extend in an upwardly vertical direction. Advantageously the side pieces of the lid extend sufficiently to enable the lid to cover the panels of the box when the box is dismantled and the lid and base panel can be fastened together with the side panels retained between them.

20 Preferably a cam retaining means is provided to prevent the cam means from being dislodged from the recess in the panel. In one embodiment, the panel comprises battens of, for example, softwood, and a sheet of, for example, plywood, the cam means being inserted in recesses in the battens  
25 and the sheet affixed over the top of the recesses, with holes arranged in the plywood sheet that are aligned with the recesses and that are of a smaller diameter than the cam means, to prevent the cam means falling out. The holes in the plywood sheet are preferably of a sufficiently large diameter to enable the rotating means, such as a screwdriver or special

key, to be inserted to rotate the cam means. In a preferred embodiment, standard assembly of the panel is used with the cam means is retained in recesses formed in the battens by means of a retaining sleeve which holds the cam means in place whilst still enabling access for the rotating means.

5 The sleeve may be metal, nylon, plastics or other suitable material. The sleeve may be inserted into or over the recess to trap the cam means in the recess. Alternatively the cam means may be inserted into the sleeve and the sleeve with the cam means fitted into the recess. The sleeve may be ridged or oversize with respect to the recess to form a "knock-in" fit but

10 alternative arrangements such as a screw-in sleeve can be used.

The use of the sleeve has a further advantage in that the panel is further protected from possible damage by the rotating means. These arrangements may also be advantageously be used for a "single piece"

15 panel made from a sheet of, for example, plywood.

If any one panel is not intended for attachment to another panel the fastening means may be removed or not included, as desired.

20 Advantageously the side panels comprise either a "female" panel or a "male" panel. Thus, each side edge of each of the side panels will have the same fastening means such that a "female" panel will have cam means at each side edge for fastening to the dowel means of two adjacent "male" panels.

25

Advantageously the panels are manufactured to have access to the cam means from one of either the interior or the exterior of the box when assembled.

In a fourth embodiment, the invention provides a box comprising a plurality of panels and a plurality of corner posts, and co-operating fastening means for fastening adjacent panels together or to fasten a panel to a corner post, wherein the fastening means comprises:

5        cam means having a cam track for insertion into one face of a first panel or a corner post; and

              dowel means having a first end for mounting in a second panel or a corner post and a second end for co-operating with the cam track;  
and wherein:

10        the first panel or corner post comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the panel or corner post to the cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted on the second panel or corner post is inserted into the hole in the edge of  
15        the first panel or corner post until the second end of the dowel means engages the cam track of the cam means and rotation of the cam means causes the second end of the dowel means to be drawn further into the hole to bring the first and second panels into close engagement to each other or to the corner post and to retain the panels together or to a corner  
20        post.

Preferably the corner posts have dowel means mounted thereon.

For assembly of two panels at right angles together, the panels are each  
25        fastened to a corner post having two faces at right angles to each other and having dowels mounted on each of the said faces for insertion into cam means mounted on each of the two panels.

For assembly of two panels at 180° to each other, for example in an extended box, the panels are each fastened to a corner post having two faces opposed to each other and having dowels mounted on each of the said faces for insertion into cam means mounted on each of the two  
5 panels.

Advantageously different length corner posts are provided for boxes of more than one panel in height. Advantageously the corner posts extend the full height of the number of panels used and the panels are fastened to  
10 the corner posts at their sides and to a vertically adjacent panel at one or both of the upper and lower edges. Alternatively a panel may be fastened to a vertically adjacent panel by means of a corner post. In a further alternative arrangement, a plurality of corner posts of the height of a single panel may be used to assemble a box of more than one panel in  
15 height, the vertically adjacent corner posts being fastened together by suitable means.

A box in accordance with the fourth embodiment of the invention comprising the corner posts has the advantage that the user can select  
20 whether to have interior or exterior access to the fastening means depending on the particular requirements of the intended use of the box.

The invention further provides a tote bin in accordance with the third or fourth embodiments of the invention. Preferably the tote bin further  
25 comprises fastening means for fastening a first tote bin to a second tote bin, the fastening means comprising cam means and dowel means for fastening the top of the first tote bin to the bottom of the second tote bin.

Preferably the fastening means comprises dowel means that may be inserted in the upper edge of a first tote bin when the tote bin is to be stacked with a second tote bin and cam means inserted at the lower edges of the side panels of the second tote bin. Thus, when the tote bins are to be stacked, the second tote bin is arranged on top of the first tote bin, the dowels are inserted into the holes and into the cam track and the cam means are rotated to draw the two bins together and hold them in stable relationship with one another. Alternatively the fastening means comprises cam means inserted at the upper edges of the first tote bin and at the lower edges of the second tote bin and double headed dowels are inserted into the cam means of the upper edge of the first bin and the lower edge of the second bin and the two cam means are both rotated to draw the two bins together. This form of fastening is also suitable for fastening two adjacent panels at 180° to one another.

The tote bin preferably further comprises carrying means such as handles or hand slots. Advantageously one end of the tote bin comprises a cut away section. Alternatively the tote bin is assembled with one end omitted. Thus, when stacked, a plurality of tote bins can be used to form a simple shelving system. The tote bin can comprise a base with co-operating fastening means for attachment to the side panels or may comprise a simple drop-in base.

Advantageously a plurality of tote bins or boxes according to the invention may be stacked on a pallet using further co-operating fastening means comprising cam means and dowel means. Advantageously the pallet is provided with a plurality of dowel means inserted therein for co-operation with cam means at the lower edges of the box or tote bin. Alternatively the fastening means may comprise cam means inserted at the edges of the

pallet to co-operate with dowels at the lower edges of the box or tote bin or for co-operation with double headed dowels which are inserted into the cam means on the pallet and at the lower edge of the box or tote bin.

- 5 Advantageously a box according to the invention may also be provided with fork lift runners attached to the base of the box by co-operating fastening means comprising cam means and dowel means.

10 In a further arrangement, a box according to the invention may further comprise one or more internal fittings attached to the box by co-operating fastening means comprising cam means and dowel means. Such internal fittings may be in the form of a plurality of bars to form a fitment to hold a piece of equipment securely within the box for transportation.

- 15 In certain arrangements, the dowel means are advantageously hinged such that they can lie flat against the side or face of the panel or corner post for storage and transportation of the panels. Preferably the dowel means are hinged in one direction only. Such dowel means may be used particularly advantageously on a lid or on the corner posts. The hinge is  
20 advantageously arranged such that all the dowel means fall into position suitable for insertion in the cam means under the effect of gravity when the corner post is positioned ready for assembly of a box.

25 The invention further provides a lid for a box, the lid comprising a panel and one or more side pieces extending in a downwardly vertical direction with respect to the normal orientation of a box and co-operating fastening means inserted in the side pieces, wherein:

the fastening means comprises cam means having a cam track for insertion into a face of a panel and dowel means having a first end for

mounting on a panel and a second end for co-operating with a cam track;  
and

the panel comprises at least one of the cam means and the dowel means inserted in at least one side piece,

5 and wherein:

if the fastening means on the side piece comprises cam means, the side piece comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the side piece to the cam track of the inserted cam means; and

10 if the fastening means on the side piece comprises dowel means the dowel means has a first end for mounting on the side piece and a second end for co-operating with a cam track of a cam means mounted on a second panel, the second end of the dowel means being inserted into a hole in the edge of the second panel until the second end of the dowel  
15 means engages the cam track of the cam means mounted on the second panel.

Advantageously the fastening means in the side pieces comprise the cam means and the dowel means are inserted in the top edges of the adjacent  
20 side panels of a box to extend in an upwardly vertical direction.

The invention further provides a pallet and co-operating fastening means, for attaching one or more boxes, tote bins or panels to said pallet, wherein:

25 the fastening means comprises cam means having a cam track for insertion into a pallet or box and dowel means having a first end for mounting on a pallet or box and a second end for co-operating with a cam track; and

the pallet comprises at least one of the cam means and the dowel means inserted in at least one side or edge of the pallet,  
and wherein:

if the fastening means on the pallet comprises cam means, the pallet  
5 comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the pallet to the cam track of the inserted cam means; and

if the fastening means on the pallet comprises dowel means the  
dowel means has a first end for mounting on the pallet and a second end  
10 for co-operating with a cam track of a cam means mounted on a box, the second end of the dowel means being inserted into a hole in the edge of the box until the second end of the dowel means engages the cam track of the cam means mounted on the box.

15 Advantageously the fastening means comprises dowel means inserted in the upward facing face of the pallet for co-operation with cam means mounted on the lower edges of further panels, bins or boxes which may be arranged on the pallet. Alternatively the fastening means may comprise cam means inserted at the edges of the pallet to co-operate with dowels at  
20 the lower edges of the box, tote bin or panel or for co-operation with double headed dowels which are inserted into the cam means on the pallet and at the lower edge of the box, tote bin or panel.

In further embodiments of the invention, one or more gaskets may be  
25 included between the panels or layer of panels. The gasket may be fitted around the fastening means or may be formed with holes corresponding to the positions of the dowel means. Gaskets may be used to improve the gas or fluid sealing of the boxes of the invention.



In a fifth embodiment, the invention provides a box comprising a plurality of panels and co-operating fastening means for fastening adjacent panels together, wherein the fastening means comprises:

5 cam means having a cam track for insertion into one face of a first panel; and

dowel means having a first end for mounting on a second panel and a second end for co-operating with the cam track;  
and wherein:

10 the first panel comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the panel to the cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted on the second panel is inserted into the hole in the edge of the first panel until the second end of the dowel means engages the cam track of the cam means and rotation of  
15 the cam means causes the second end of the dowel means to be drawn further into the hole in the first panel to bring the first and second panels into close engagement and to retain the panels together.

20 Preferably the hole extending from the edge of the panel is enlarged at the exit from the edge of the panel to facilitate insertion of the dowel means.

Advantageously a slot is formed in the face of the panel through to the hole such that at least part of the hole is open to the face of the panel. This enables the dowel means to be inserted into the slot and thence into  
25 the hole from the face of the panel for insertion into the cam means. This is particularly advantageous for the last side panel in assembly of a box when the base and other side panels are already assembled and also enables the last panel to be more easily removed when the box is dismantled. Preferably the slot extends to the cam means so that the

dowel means can be inserted into the cam means from the back instead of the side. Advantageously one or more of the panels include slots through to the dowel insertion holes.

- 5 In a sixth embodiment, the invention provides a box comprising a plurality of panels and a plurality of corner posts, and co-operating fastening means for fastening adjacent panels together or to fasten a panel to a corner post, wherein the fastening means comprises:

cam means having a cam track for insertion into one face of a first  
10 panel or a corner post; and

dowel means having a first end for mounting in a second panel or a corner post and a second end for co-operating with the cam track;  
and wherein:

the first panel or corner post comprises a recess in one face into  
15 which the cam means is inserted and a hole extending from the edge of the panel or corner post to the cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted on the second panel or corner post is inserted into the hole in the edge of the first panel or corner post until the second end of the dowel means  
20 engages the cam track of the cam means and rotation of the cam means causes the second end of the dowel means to be drawn further into the hole to bring the first and second panels into close engagement to each other or to the corner post and to retain the panels together or to a corner post.

25

The invention will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 shows an exploded view of a box in accordance with a first embodiment of the invention;

- Figure 2 shows an enlarged side view of the connector shown in Figure 1;  
Figure 3 shows an enlarged cross-sectional view of a panel of a box as shown in Figure 1;  
Figure 4 shows a perspective view of a box in accordance with a second  
5 embodiment of the invention;  
Figure 4a shows two panels and a connecting post as described with reference to Figure 4; and  
Figure 5 shows a perspective view of tote bins in accordance with the invention;  
10 Figure 6 shows an exploded view of a box in accordance with a third embodiment of the invention;  
Figures 7a,b,c show perspective views of alternative arrangements for holding the cam means in the panel in accordance with the invention;  
Figure 8a shows a side view of the cam means shown in Figure 6;  
15 Figure 8b shows an end view of the cam means of Figure 7a;  
Figure 8c shows a side view of the dowel means shown in Figure 6;  
Figure 8d shows a side view of a key for rotating the cam means of Figures 8a and 8b;  
Figure 9 shows a perspective view of a box in accordance with a fourth  
20 embodiment of the invention;  
Figure 10 shows part of a corner post and adjacent panels of the box of Figure 9;  
Figure 11 shows a perspective view of tote bins in accordance with the invention;  
25 Figure 12 shows a side view in the direction of Arrow A of Figure 11;  
Figure 13 shows a perspective view of alternative internal fittings for boxes according to the invention;  
Figures 14a,b and c show a pallet and fastening means according to the invention; and

Figures 15 and 15a show an alternative arrangement of a panel of a box according to the invention.

A first embodiment of the box of the invention is shown in Figure 1. A box 1 comprises a base panel 2, one or more pairs of side panels 3,4 and one or more pairs of end panels 5,6. In the example illustrated, each side 3,4 and end 5,6 has three panels but it will be appreciated that the sides and ends may comprise a single panel or as many panels as required. Each of the panels 3,4,5,6 is fastened to its neighbouring panels by co-operating fastening means 7,8 comprising a two part catch 7a and a retaining means 8a. The fastening means can be seen in more detail in Figures 2 and 3.

The base panel 2 is fitted with only retaining means 8a and the lower edge 3a,4a,5a,6a of each side panel 3,4 and end panel 5,6 has a two part catch 7a. For full interchangeability, each side and end panel 3,4,5,6 has retaining means 8a fitted to its upper edge 3b,4b,5b,6b as well. The panels 2,3,4,5,6 are standard wood panels made from softwood battens 10 and a plywood insert 11. The two-part catch 7a is inserted into an elongate hole 12 in the batten 10. The two-part catch 7a and the hole 12 are dimensioned such that the catch 7a can be fully retracted into the hole 12.

The elements of the fastening means are shown in detail in Figures 2 and 3.

The retaining means 8a comprises a collar having a self-tapping thread 207 that is inserted into a bore 208 within the panel 3. The bore 208 is drilled within the panel 6 and is of a diameter such that the self-tapping

thread 207 of the collar 8a grips firmly within the bore 208. The depth of the bore 208 is of sufficient depth so that the bottom of the bore 208 does not interfere with the fitting of the collar 8a. The inner face 209 of the collar 8a is formed as an angled face within the inner bore of the collar 8a.

The catch 7a comprises two complimentary parts, an engagement portion 210 and a plunger portion 211. The catch 7a is positioned in an elongate hole 12 in the panel 3. The engagement portion 210 comprises a body portion 212 and anchor means 214 in the form of a two fingered collet which forms a split cylinder having two sides, or fingers, 214a,214b. The fingers 214a,214b are formed of a resilient material such that they can be deformed outwardly by a force and will return to a rest position when the force is removed.

The plunger portion 211 comprises a body portion 215 and a plunger 216. The plunger 216 fits within the fingers 214a,214b of the anchor means 214. The body portions 212,215 of the engagement portion 210 and plunger portion 211 respectively are each formed as approximately half the depth of the cylinder formed when the plunger 216 is positioned within the fingers 214a,214b. Thus, the body portions 212,215 lie in adjacent relationship as part of the catch 7a.

The body portions 212,215 have an interior 212a,215a respectively with teeth 217,218 formed on one surface thereof. The teeth 217,218 of the respective body portions 212,215 can be positioned in alignment for engagement with the movement means 204.

The movement means 204 comprises a splined key 219 having a shaft 219a with splines 219b that engage with the teeth 217,218 on the body portions 212,215. The shaft 219a is inserted through the body portions 212,215 through an access hole 224 (Figure 3) in the panel 3, the access  
5 hole 224 extending orthogonally to the elongate hole 12, and extending into the panel 3 on the far side of the elongate hole 12 to form a retaining bore 225 for the end of the splined shaft 219a. This enables the shaft 219a to be retained in position with respect to the catch 7a so that it does not dislodge.

10

In operation, to connect two panels 3,6 together, the collar 8a is inserted into the bore 208 in the panel 6 and the catch 7a, comprising the engagement portion 210 and the plunger portion 211 in co-operative engagement with each other, is inserted into the elongate hole 12 in the  
15 panel 3. The hole 12 is longer than the catch 7a such that the catch 7a can be fully retracted within the panel 3 when not in use. The length of the hole 12 is determined by the relationship between the length of the catch 7a and the position of the orthogonal access hole 224 through the elongate hole 12.

20

A small lug 212b extends beyond the end of the body portion 212 of the engagement portion 210 to ensure correct alignment of the two catch components 210,211 during installation. The shaft 219a is inserted through the access hole 224 and through the interior portions 212a,215a of  
25 the body portions 212,215 of the engagement portion 210 and the plunger portion 211 respectively. The splines 219b on the splined shaft 219a engage with the teeth 217,218 on the interior surfaces 212a,215a of the body portions 212,215. A slight rotation of the shaft 219a will bring the shaft 219a into engagement from any entry orientation.

To operate the connector, panel 3 is positioned adjacent the panel 6 with the bore 208 in alignment with the end of the elongate hole 12. The shaft 219a is rotated and the splines 219b on the shaft 219a engage with the teeth 217,218 to move the catch 7a forwards towards the end of the elongate hole 12 and into the collar 8a. When the fingers 214a,214b are inserted into the collar 8a far enough such that angled grip faces 220 at the ends of the fingers 214a,214b are in alignment with the angled face 209 of the collar 8a, the splines 219b of the shaft 219a slip into a free-wheel position 221 on the engagement portion 210. The splines 219b are still engaged with the teeth 218 of the plunger portion 211 and continued rotation of the shaft 219a will move the plunger portion 211 further forward. This forces the plunger 216 between the angled grip faces 220, moving them outwards until they engage with the angled face 209 of the collar 8a. At this position, ridges 222 on the surface of the plunger 216 click into engagement with notches 223a on the interior surface of the fingers 214a,214b. This "click" can be felt by an operator rotating the shaft 219a and thus gives an indication that the catch 7a has engaged with the collar 8a.

20

When the connector is thus engaged, the angled grip faces 220 act against the angled face 209 of the collar 8a to hold the two panels 3 and 6 together. The shaft 219a within the catch 7a holds the engagement portion 210 and the plunger portion 211 in position such that the catch 7a cannot be disengaged without an element of force on the shaft 219a to rotate it to retract the catch 7a. The engagement of the ridges 222 and the notches 223a gives an additional retention force to prevent inadvertent disengagement.

25

To disengage the connector, the shaft 219a is rotated in the opposite direction to retract the catch 7a. A certain degree of force is required to disengage the ridges 222 from the notches 223a to enable the catch 7a to be retracted. As the shaft 219a is rotated, the splines 219b engage with  
5 the teeth 218 on the plunger portion 211, moving it back into the elongate hole 12. As the plunger 216 moves back through the fingers 214a,214b, the resilient fingers 214a,214b spring back to their release position, disengaging the grip faces 220 from the angled face 209 of the collar 8a. As the plunger portion 211 is retracted further, the ridges 222 engage with  
10 a rear set of notches 223b on the interior surface of the fingers 214a,214b to move the engagement portion 210 back, thus moving the teeth 217 back into engagement with the splines 219b of the shaft 219a. Continued rotation of the shaft 219a moves both the engagement portion 210 and the plunger portion 211 back together into the elongate hole 12 until the catch  
15 7a is retracted within the hole 12.

The notches 223b serve to engage the engagement portion 210 and the plunger portion 211 together for movement of the catch 7a and the notches 223a serve to indicate engagement of the catch 7a with the collar 8a and to  
20 prevent accidental disengagement of the connector.

When the two panels 3,6 are disconnected, none of the parts of the connector extend beyond the surface of the panels 3 or 6, which allows any risk of damage to the connector when the connector is disengaged to  
25 be minimised.

Figure 3 shows the arrangement of the elongate hole 12 and the access hole 224 in the panel 3. The panel 3 is shown as comprising a batten 10 and a panel 11, fastened together. The elongate hole 12 extends into the



batten 10 from the edge of the panel 3 such that the catch 7a can be inserted into the elongate hole 12 lengthways. Because it is advantageous for a user to be able to operate the connector in a constant direction, it is undesirable for the catch 7a to be able to be inserted into the hole 12 in  
5 either orientation and the hole 12, therefore, has a modified circular cross-section, such as a "D" shape or with a circumferentially positioned orientation hole.

The access hole 224 for the splined key 219 extends from the face of the  
10 batten 10, through the elongate hole 12 and into the retaining bore 225 on the inner face of the panel 11. An insert sleeve 226 within the bore 225 engages a ridge 227 on the end of the shaft 219a to give a "click" fit, which serves to indicate to an operator that the shaft 219a is engaged and also prevents inadvertent disengagement of the key 219.

15 As shown in Figure 3, the splined shaft 219a has a head 228. The head 228 may have a particular pattern to correspond to a key such that rotation of the shaft 219a may only be carried out by an operator having a key corresponding to the particular pattern. This arrangement adds to the  
20 security of assembly of boxes, crates and so on.

The tolerances of the catch 7a, the elongate hole 12, the access hole 224 and the shaft 219a are all closely defined to limit relative movement of the parts of the connector and thus reduce any chances of inadvertent  
25 dislodgement of the separate parts of the connector or disengagement of the connector from its connected position.

In the embodiment of Figure 1, each panel 3,4,5,6 has catch fittings 7a on the lower edge 3a,4a,5a,6a and retaining means 8a on the upper edge

3b,4b,5b,6b for fitting to the lower edge 3a,4a,5a,6a of a vertically adjacent panel. Each side edge 3c,4c of each side panel 3,4 is fitted with catch fittings 7a and each side edge 5c,6c of each end panel is fitted with retaining means 8a. The fastenings are arranged for either interior or exterior access to the catch fittings 7a, depending on the requirements of the user for increased accessibility or increased security.

For fastening two adjacent panels together at right angles as shown, the retaining means 8a are inserted into a face 5d,6d adjacent the edge 5c,6c of the end panel 5,6. In an alternative arrangement of panels, to form a larger box for example, the panels may be fastened together at 180° in a straight line and in this arrangement the retaining means 8a are inserted into the side edge 5c,6c of the end panel 5,6, such that the extended side of such a box comprises alternating side and "end" panels 3,4,5,6.

As shown in Figure 1, box 1 also comprises a lid 25 comprising a panel similar to the side and end panels 3,4,5,6 but having depending side pieces 26 to accommodate catch fittings 7a. The catch fittings 7a in the side pieces 26 engage with retaining means 8a in the top edges 3b,4b,5b,6b of the top panels.

In a preferred arrangement, the side pieces 26 extend far enough so that when the box 1 is dismantled all the side and end panels 3,4,5,6 may be arranged on the base 2 and the lid 25 can be placed over the top and fastened to retaining means 8a on the base 2 for secure storage and transportation of the dismantled box 1.

A second embodiment of the invention is shown in Figure 4. In this embodiment, box 400 has a base 2, side panels 3,4 and end panels 5,6.

Each side and end panel 3,4,5,6 is fastened to the base 2 as shown in and described with respect to Figure 1 but the side and end panels 3,4,5,6 are fastened to each other by means of connecting posts 27.

- 5 In the embodiment illustrated in Figures 4 and 4a, the retaining means 8a of the fastening means are inserted in the connecting posts 27 and the catch fittings 7a are inserted adjacent the side edges 3c,4c,5c,6c of the side and end panels 3,4,5,6. For right angle connection of the panels, as shown, the retaining means 8a are inserted into adjacent faces of the  
10 connecting post 27. For connection of the panels in a straight line, the retaining means 8a are inserted into opposing faces of the connecting post 27, as shown in Figure 4a.

- The fastenings can be arranged by the user for either interior or exterior  
15 access to the catch fittings 7a, depending on requirements for increased accessibility or increased security.

- Figure 5 shows a pair of tote bins 500,501 in accordance with the first embodiment of the invention. Tote bins 500,501 can also be made in  
20 accordance with the second embodiment of the invention (not shown). The tote bin 500,501 is constructed similarly to the box 1 shown in and described with respect to Figure 1. The tote bin 500,501 further comprises fastening means for fastening a first tote bin 500 to a second tote bin 501, the fastening means comprising catch fittings 7a and  
25 retaining means 8a as previously described to attach the top of the first tote bin 500 to the bottom of the second tote bin 501.

In the arrangement illustrated in Figure 5, retaining means 8a are inserted in the upper edges 502 of the side panels 3,4,5,6 of the first tote bin 500

when the tote bin 500 is to be stacked with a second tote bin 501 and catch fittings 7a are inserted at the lower edges 503 of the side panels 3,4,5,6 of the second tote bin 501. Thus, when the tote bins 500,501 are to be stacked, the second tote bin 501 is arranged on top of the first tote bin 502, the retaining means 8a are inserted into the bores 208 in the lower edges 503 of the side panels 3,4,5,6 of the second tote bin 501 and the catch fittings 7a are moved along the elongate holes 12 to engage with the retaining means 8a and thus draw the two bins 500,501 together and hold them in stable relationship with one another. The end panels 5,6 of the tote bins 500,501 include cut-outs 504 to form handles.

The third and fourth embodiments of the invention are illustrated in Figures 6 to 14. In these Figures, similar elements to those shown in Figures 1 to 5 are given the same reference numerals.

15

A third embodiment of the box of the invention is shown in Figure 6. A box 1 comprises a base panel 2, one or more pairs of side panels 3,4 and one or more pairs of end panels 5,6. In the example illustrated, each side 3,4 and end 5,6 has three panels but it will be appreciated that the sides and ends may comprise a single panel or as many panels as required. Each of the panels 3,4,5,6 is fastened to its neighbouring panels by co-operating fastening means 7,8 comprising a cam fitting 7b and a dowel 8b. The fastening means can be seen in more detail in Figure 10, which illustrates the fastening means with respect to the fourth embodiment of the invention but which applies similarly to the third embodiment, and in Figures 8a,b and c.

25

The dowels 8b are screwed into plastic inserts 9 in the base, side or end panels 2,3,4,5,6. The plastics insert 9 improves the repairability of the

box as if it is damaged it may simply be replaced. The dowels may be screwed directly into the panel but this may be more difficult to repair, or the panel may need to be completely replaced if it is damaged. The dowels 8b can be inserted and removed as required.

5

The base panel 2 is fitted with only dowels 8b and the lower edge 3a,4a,5a,6a of each side panel 3,4 and end panel 5,6 has a cam fitting 7b. For full interchangeability, each side and end panel 3,4,5,6 has dowels 8b fitted to its upper edge 3b,4b,5b,6b as well. The panels 2,3,4,5,6 are  
10 standard wood panels made from softwood battens 10 and a plywood insert 11. The cam fitting 7b is inserted into a recess 12b in the batten 10. The cam fittings 7b must be held securely in the recesses 12b so that they cannot fall out during assembly and use of the box. Figures 7a,b and c show preferred means of ensuring this: one way, as shown in Figure  
15 7a, is to make the recess 12b in the battens 10 and then fasten the plywood insert 11 over the top. The plywood insert 11 has holes 12a formed therein corresponding to the positions of the recesses 12b but of a smaller diameter so that the cam fitting 7b in the recess 12b cannot fall out. Two further alternatives are shown in Figures 7b and c in which the panels  
20 2,3,4,5,6 are made in the normal way and the recesses 12b are then formed in the battens 10. As shown in Figure 7b, the cam fitting 7b is inserted in the recess 12b and a retaining sleeve 14 is fitted into the recess 12b by a knock-in or screw-in fit to retain the cam fitting 7b safely in place. In the arrangement shown in Figure 7c, the cam fitting 7b is fitted  
25 in a sleeve 14a, which is ridged or oversize to secure it in the recess 12b and the combination of the cam fitting 7b and sleeve 14a is inserted into the recess 12b.

The elements of the fastening means are shown in detail in Figures 8a,b and c. Cam fitting 7b has a cam track 15 and opening 16. Dowel 8b has a screw thread 17 at one end and a groove 18 and head 19 at the other end. When two panels are joined together, the dowel head 19 is inserted  
5 into a hole 20 extending from the recess 12b to the edge 21 of the panel 3,4,5,6. The dowel 8b is inserted until the head 19 enters the opening 16 of the cam fitting 7b. To engage the fastening means, cam fitting 7b is rotated by a key 22 which has a key face 23 of a corresponding configuration to lock face 24 of the cam fitting 7b. In an alternative  
10 version (not shown), the lock face 24 may correspond to a screwdriver or allen key fitting for rotation. As the cam fitting 7b is rotated, the groove 18 fits along the cam track 15 and the head 19 is drawn into the cam fitting 7b.

15 The position of the recess 12b for the cam fitting 7b and the hole 20 must be determined accurately to ensure the precise positioning of the fastening means and to ensure that the panels 2,3,4,5,6 are drawn into close proximity when the fastening is tightened by rotating the cam fitting. The fastening can be released by rotating the cam fitting 7b in the opposite  
20 direction.

In the embodiment of Figure 6, each panel 3,4,5,6 has cam fittings 7b on the lower edge 3a,4a,5a,6a and dowels 8b on the upper edge 3b,4b,5b,6b for fitting to the lower edge 3a,4a,5a,6a of a vertically adjacent panel.  
25 Each side edge 3c,4c of each side panel 3,4 is fitted with cam fittings 7b and each side edge 5c,6c of each end panel is fitted with dowels 8b. The fastenings are arranged for either interior or exterior access to the cam fittings 7b, depending on the requirements of the user for increased accessibility or increased security.

For fastening two adjacent panels together at right angles as shown, the dowels 8b are inserted into a face 5d,6d adjacent the edge 5c,6c of the end panel 5,6. In an alternative arrangement of panels, to form a larger box  
5 for example, the panels may be fastened together at 180° in a straight line and in this arrangement the dowels 8b are inserted into the side edge 5c,6c of the end panel 5,6, such that the extended side of such a box comprises alternating side and "end" panels 3,4,5,6.

10 As shown in Figure 6, box 1 also comprises a lid 25 comprising a panel similar to the side and end panels 3,4,5,6 but having depending side pieces 26 to accommodate cam fittings 7b. The cam fittings 7b in the side pieces 26 engage with dowels 8b in the top edges 3b,4b,5b,6b of the top panels. If no lid 25 is required, the top panels may either be made with  
15 no dowel fittings 8b or the dowels 8b may be removed.

In a preferred arrangement, the side pieces 26 extend far enough so that when the box 1 is dismantled all the side and end panels 3,4,5,6 may be arranged on the base 2 and the lid 25 can be placed over the top and  
20 fastened to dowels 8b on the base 2 for secure storage and transportation of the dismantled box 1.

A fourth embodiment of the invention is shown in Figure 9. In this embodiment, box 400 has a base 2, side panels 3,4 and end panels 5,6.  
25 Each side and end panel 3,4,5,6 is fastened to the base 2 as shown in and described with respect to Figure 6 but the side and end panels 3,4,5,6 are fastened to each other by means of corner posts 27. The fastening arrangement is shown in more detail in Figure 10.

In the embodiment illustrated in Figures 9 and 10, the dowels 8b of the fastening means are inserted in the corner posts 27 and the cam fittings 7b are inserted adjacent the side edges 3c,4c,5c,6c of the side and end panels 3,4,5,6. For right angle connection of the panels, as shown, the dowels 8b are inserted into adjacent faces 27a,27b of the corner post 27. For connection of the panels in a straight line, the dowels 8b are inserted into opposing faces 27a,27c of the corner post 27. The fastenings can be arranged by the user for either interior or exterior access to the cam fittings 7b, depending on requirements for increased accessibility or increased security.

The dowels 8b may include a hinge (not shown) such that when the corner post 27 is positioned for assembly of the box 400 the dowels 8b fall into the correct position under the effect of gravity but when the corner post 27 is removed for transportation or storage the dowels 8b can be laid flat against the sides of the corner post 27.

As shown in Figures 6 and 9, fork lift runners 28 can be fastened to the base 2 of the box 1,400 by conventional means or by cam and dowel fittings 7,8 as used to fasten the panels 2,3,4,5,6 of the together.

Figure 11 shows a pair of tote bins 600,601 in accordance with the third embodiment of the invention. Tote bins 600,601 can also be made in accordance with the fourth embodiment of the invention (not shown). The tote bin 600,601 is constructed similarly to the box 1 shown in and described with respect to Figure 6. The tote bin 600,601 further comprises fastening means for fastening a first tote bin 600 to a second tote bin 601, the fastening means comprising cam fittings 7b and dowels 8b as previously described to attach the top of the first tote bin 600 to the



bottom of the second tote bin 601. In the arrangement illustrated in Figure 11, dowels 8b are inserted in the upper edges 602 of the side panels 3,4,5,6 of the first tote bin 600 when the tote bin 600 is to be stacked with a second tote bin 601 and cam fittings 7b are inserted at the lower edges 603 of the side panels 3,4,5,6 of the second tote bin 601. Thus, when the tote bins 600,601 are to be stacked, the second tote bin 601 is arranged on top of the first tote bin 602, the dowels 8b are inserted into the holes 20 in the lower edges 603 of the side panels 3,4,5,6 of the second tote bin 601 and into the cam track 19 and the cam fittings 7b are rotated to draw the two bins 600,601 together and hold them in stable relationship with one another.

In an alternative arrangement shown in Figure 12, the fastening means comprises cam fittings 7b inserted at the upper edges 602 of the first tote bin 600 and at the lower edges 603 of the second tote bin 601 and double headed dowels 8c are inserted into the cam fittings 7b of the upper edge 602 of the first bin 600 and the lower edge 603 of the second bin 601 and the two cam fittings 7b are both rotated to draw the two bins 600,601 together.

20

The end panels 5,6 of the tote bins 600,601 include cut-outs 604 to form handles.

Figure 13 shows possible alternatives for interior fitting for a box 1. A fitment 801 is formed from two co-operating sections 802,803 with a cam 7b in one portion and a dowel 8b in the other. The two sections 802,803 are fastened together to hold an item (not shown) in place in the box 1. An alternative fitting 804 is attached to the base of the box 1 by dowel 8b

and cam fittings 7b and a further fitting 805 is shown attached to the side of the box 1.

Figure 14a shows a pallet 900 according to the invention. The pallet 900  
5 shown is a four-way pallet but may be two-way, reversible, non-reversible etc. as required. The pallet 900 comprises a top face 901 and a bottom face 902 attached to crosspieces 903. Two alternative fastenings for attaching boxes, panels or tote bins to the pallet are shown in Figures 14b and c. Figure 14b shows a cam 7b mounted within the pallet 900 in a  
10 crosspiece 903 and Figure 14c shows a dowel 8b attached to the top face 901 of the pallet 900.

Figure 15 shows a panel 910 of a box according to the invention. The panel 910 is similar to the panels shown in Figures 6 and 9 and includes  
15 cam means 7b inserted in recess 12b in a face 911 of the panel 910. A slot 912 extends from the edge 913 of the panel and is open to the face 911 of the panel. Thus, when a second panel 914 (or corner post 27, not shown) is attached to the first panel 910, a dowel 8b on the second panel 914 passes into the cam means 7b from the back instead of the side as  
20 shown in the arrangement of Figure 6, for example. This enables the panel 910 to be removed and assembled when the other three panels 914a, 914b, 915 are in place, as shown in Figure 15a.

The boxes of the invention are easy to assemble and dismantle and enable  
25 any damaged or missing parts to be repaired or replaced individually, leading to increased reusability and recyclability of packaging. The boxes are extremely versatile and can be used in a variety of configurations depending on the requirements of the user.

## CLAIMS

1. A box comprising a plurality of panels and co-operating fastening means for fastening adjacent panels together, wherein the fastening means comprises:
- 5 retaining means in a first panel;  
a catch member inserted in an elongate hole in a second panel, the catch member comprising an engagement portion having movable anchor means and an operating portion having operating means for moving the anchor means; and
- 10 means to move the engagement portion and the operating portion along the elongate hole.
2. A box comprising a plurality of panels and a plurality of connecting posts, and co-operating fastening means for fastening adjacent panels
- 15 together or to fasten a panel to a connecting post, wherein the fastening means comprises:
- retaining means in a first panel or a connecting post;  
a catch member inserted in an elongate hole in a second panel or a connecting post, the catch member comprising an engagement portion
- 20 having movable anchor means and an operating portion having operating means for moving the anchor means; and  
means to move the engagement portion and the operating portion along the elongate hole.
- 25 3. A box according to claim 1 or claim 2 wherein the operating portion or the fastening means comprises a plunger portion having plunger means.
4. A box according to any one of the preceding claims wherein the
- 30 second panel further includes an access hole extending at right angles to, and into, the elongate hole.
5. A box according to any one of the preceding claims wherein the retaining means of the fastening means comprises a collar.
- 35 6. A box according to claim 5 wherein the collar has an angled face for co-operation with the anchor means.

7. A box according to claim 5 or claim 6 when dependent on claim 3 wherein the movement means of the fastening means moves the engagement portion and the plunger portion along the elongate hole towards and into the collar to engage the connector and moves the engagement portion and the plunger portion along the elongate hole away from the collar and back into the elongate hole to disengage the connector.
8. A box according to claim 7 wherein, as the engagement portion and the plunger portion are moved along the elongate hole to engage with the collar, the anchor means is moved into an engagement position relative to the collar.
9. A box according to claim 8 wherein the engagement portion is preferably disengaged from the moving means while the plunger portion continues to be moved by the moving means with respect to the engagement portion such that the plunger means is advanced between the anchor means within the collar to move the anchor means into engagement with the collar.
10. A box according to any one of the preceding claims wherein the engagement portion of the fastening means comprises a body portion attached to the anchoring means.
11. A box according to claim 10 when dependent on claim 2 wherein the plunger portion of the fastening means comprises a body portion attached to the plunger means.
12. A box according to claim 11 wherein the plunger means is arranged within the anchor means and the respective body portions are arranged adjacent one another.
13. A box according to claim 12 wherein the anchor means comprises a two-fingered collet.
14. A box according to claim 13 wherein the body portion of the anchor means includes a disengagement portion such that, as the catch

means is advanced by the movement means, the anchor means moves into position relative to the collar, the movement means then disengages from the anchor means but remains in engagement with the plunger means so that the plunger is advanced further between the fingers of the anchor  
5 portion, forcing the fingers apart and into engagement with the collar to hold the two parts together.

15. A box according to claim 13 or claim 14 when dependent on claim  
6 wherein the end faces of the fingers are angled to co-operate with the  
10 angled face of the collar.

16. A box according to any one of claims 13 to 15 wherein the fingers are resilient such that the movement of the plunger through the anchor means causes the fingers to be forced outward and retraction of the  
15 plunger through the anchor means allows the anchor means to return to their original position.

17. A box according to any one of claims 13 to 16 wherein the inner surface of the fingers and the plunger means are formed with co-operating  
20 notches and ridges to indicate when the anchor means is in engagement with the collar and/or to retain the connector in the engaged position.

18. A box according to claim 17 wherein a further set of co-operating notches is provided to serve as an engagement means with the ridges when  
25 the catch is retracted to withdraw the anchor means with the plunger means.

19. A box according to any one of the preceding claims wherein the elongate hole is dimensioned such that the catch means is within the panel  
30 when it is fully retracted.

20. A box according to claim 19 wherein the catch means is formed with a protruding lug at its inner end.

35 21. A box according to any one of the preceding claims when dependent on claim 10 wherein the body portion of the anchor means comprises teeth for engagement with the movement means.

22. A box according to any one of the preceding claims when dependent on claim 11 wherein the body portion of the plunger means comprises teeth for engagement with the movement means.
- 5 23. A box according to claim 22 when dependent on claim 21 wherein the respective body portions are formed as complimentary sections, each being half the thickness of the catch means and each having complimentary sets of teeth for engagement by the movement means, such  
10 that the movement means engages with both sets of teeth to move both the engagement portion and the plunger portion.
24. A box according to claim 23 when dependent on claim 4 wherein the movement means comprises a key having a splined shaft which is  
15 inserted through the access hole.
25. A box according to claim 24 wherein the shaft passes right through both body portions and engages with a co-operating hole in the panel to the rear side of the elongate hole.  
20
26. A box according to claim 25 wherein an insert sleeve is mounted in the co-operating hole.
27. A box according to claim 26 wherein the insert sleeve has a "click"  
25 fitting to indicate to an operator when the splined shaft is in engagement and/or to prevent inadvertent disengagement of the splined shaft.
28. A box according to claim 24 when dependent on claim 14 wherein the disengagement portion comprises a free wheel position at the end of  
30 the teeth section on the anchor portion.
29. A box according to any one of the preceding claims wherein the box comprises a tote bin in accordance with the first or second embodiments of the invention.  
35
30. A tote bin according to claim 29 wherein the tote bin further comprises fastening means for fastening a first tote bin to a second tote

bin, the fastening means comprising retaining means in a first tote bin, a catch member inserted in an elongate hole in a second tote bin, the catch member comprising an engagement portion having movable anchor means and an operating portion having operating means for moving the anchor means, and means to move the engagement portion and the operating portion along the elongate hole, for fastening the top of the first tote bin to the bottom of the second tote bin.

31. A plurality of tote bins or boxes according to any one of the preceding claims stacked on a pallet using further co-operating fastening means.

32. A box comprising a plurality of panels and co-operating fastening means for fastening adjacent panels together, wherein the fastening means comprises:

cam means having a cam track for insertion into one face of a first panel; and

dowel means having a first end for mounting on a second panel and a second end for co-operating with the cam track;

and wherein:

the first panel comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the panel to the cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted on the second panel is inserted into the hole in the edge of the first panel until the second end of the dowel means engages the cam track of the cam means and rotation of the cam means causes the second end of the dowel means to be drawn further into the hole in the first panel to bring the first and second panels into close engagement and to retain the panels together.

33. A box according to claim 32 wherein the dowel means is mounted in an insert mounted in the face or edge of the second panel.

34. A box according to claim 32 or 33 wherein the second end of the dowel is formed with a groove for co-operating engagement with the cam track.

5

35. A box according to any one of claims 32 to 34 wherein the cam means is rotatable in the recess such that the cam track moves relatively to the second end of the dowel to pull the dowel inwardly to fasten the adjacent panels together.

10

36. A box according to claim 35 wherein the cam means is formed with a selected lock formation such that it can only be rotated by means of a key that corresponds to the selected lock formation.

15

37. A box according to any one of claims 32 to 36 wherein one of the panels of the box comprises a base panel and at least three, but preferably four or multiples of four, of the panels comprise side panels.

38. A box according to claim 37 wherein the fastening means on the base panel comprises dowel means inserted in the upward face of the panel to extend in an upwardly vertical direction, with respect to the normal orientation of the box, and the fastening means on the lower edge of the side panels comprises cam means with a hole extending in an upwardly vertical direction from the lower edge of the side panels.

25

39. A box according to any one of claims 32 to 38 wherein one of the panels of the box comprises a top panel or lid.



40. A box according to claim 39 wherein the lid comprises one or more side pieces that extend in a downwardly vertical direction, with respect to the normal orientation of the box, and the fastening means are inserted in the side piece.

5

41. A box according to claim 40 wherein the fastening means in the side pieces comprise the cam means and the dowel means are inserted in the top edge of the adjacent side panels to extend in an upwardly vertical direction.

10

42. A box according to claim 40 or claim 41 wherein the side pieces of the lid extend sufficiently to enable the lid to cover the panels of the box when the box is dismantled and the lid and a base panel can be fastened together with the side panels retained between them.

15

43. A box according to any one of claims 32 to 42 wherein a cam retaining means is provided to prevent the cam means from being dislodged from the recess in the panel.

20 44. A box comprising a plurality of panels and a plurality of corner posts, and co-operating fastening means for fastening adjacent panels together or to fasten a panel to a corner post, wherein the fastening means comprises:

25 cam means having a cam track for insertion into one face of a first panel or a corner post; and

dowel means having a first end for mounting in a second panel or a corner post and a second end for co-operating with the cam track;  
and wherein:

the first panel or corner post comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the panel or corner post to the cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted  
5 on the second panel or corner post is inserted into the hole in the edge of the first panel or corner post until the second end of the dowel means engages the cam track of the cam means and rotation of the cam means causes the second end of the dowel means to be drawn further into the hole to bring the first and second panels into close engagement to each  
10 other or to the corner post and to retain the panels together or to a corner post.

45. A box according to claim 44 wherein different length corner posts are provided for boxes of more than one panel in height.

15

46. A box according to claim 45 wherein the corner posts extend the full height of the number of panels used and the panels are fastened to the corner posts at their sides and to a vertically adjacent panel at one or both of the upper and lower edges.

20

47. A box in accordance with any one of claims 32 to 46 wherein the box comprises a tote bin.

48. A tote bin according to claim 47 wherein the fastening means  
25 comprises cam means inserted at the upper edges of a first tote bin and at the lower edges of a second tote bin and double headed dowels are inserted into the cam means of the upper edge of the first bin and the lower edge of the second bin and the two cam means are both rotated to draw the two bins together.

49. A box according to any one of claims 32 to 46 further comprising one or more internal fittings attached to the box by co-operating fastening means comprising cam means and dowel means.

5

50. A box according to claim 49 wherein the internal fittings comprise a plurality of bars attached by cam means and dowel means to form a fitment to hold a piece of equipment securely within the box for transportation.

10

51. A box according to any one of claims 32 to 50 wherein the dowel means are hinged such that they can lie flat against the side or face of the panel or corner post for storage and transportation of the panels.

15

52. A box according to any one of the preceding claims wherein one or more gaskets are included between the panels or layer of panels.

53. A plurality of boxes or tote bins according to any one of claims 32 to 52 stacked on a pallet using further co-operating fastening means comprising cam means and dowel means.

20

54. A lid for a box, the lid comprising a panel and one or more side pieces extending in a downwardly vertical direction with respect to the normal orientation of a box and co-operating fastening means inserted in the side pieces, wherein:

25

the fastening means comprises cam means having a cam track for insertion into a face of a panel and dowel means having a first end for mounting on a panel and a second end for co-operating with a cam track; and

the panel comprises at least one of the cam means and the dowel means inserted in at least one side piece, and wherein:

if the fastening means on the side piece comprises cam means, the side piece comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the side piece to the cam track of the inserted cam means; and

if the fastening means on the side piece comprises dowel means the dowel means has a first end for mounting on the side piece and a second end for co-operating with a cam track of a cam means mounted on a second panel, the second end of the dowel means being inserted into a hole in the edge of the second panel until the second end of the dowel means engages the cam track of the cam means mounted on the second panel.

15

55. A lid according to claim 54 wherein the fastening means in the side pieces comprise the cam means and the dowel means are inserted in the top edges of the adjacent side panels of a box to extend in an upwardly vertical direction.

20

56. A pallet and co-operating fastening means, for attaching one or more boxes, tote bins or panels to said pallet, wherein:

the fastening means comprises cam means having a cam track for insertion into a pallet or box and dowel means having a first end for mounting on a pallet or box and a second end for co-operating with a cam track; and

the pallet comprises at least one of the cam means and the dowel means inserted in at least one side or edge of the pallet, and wherein:

if the fastening means on the pallet comprises cam means, the pallet comprises a recess in one face into which the cam means is inserted and a hole extending from the edge of the pallet to the cam track of the inserted cam means; and

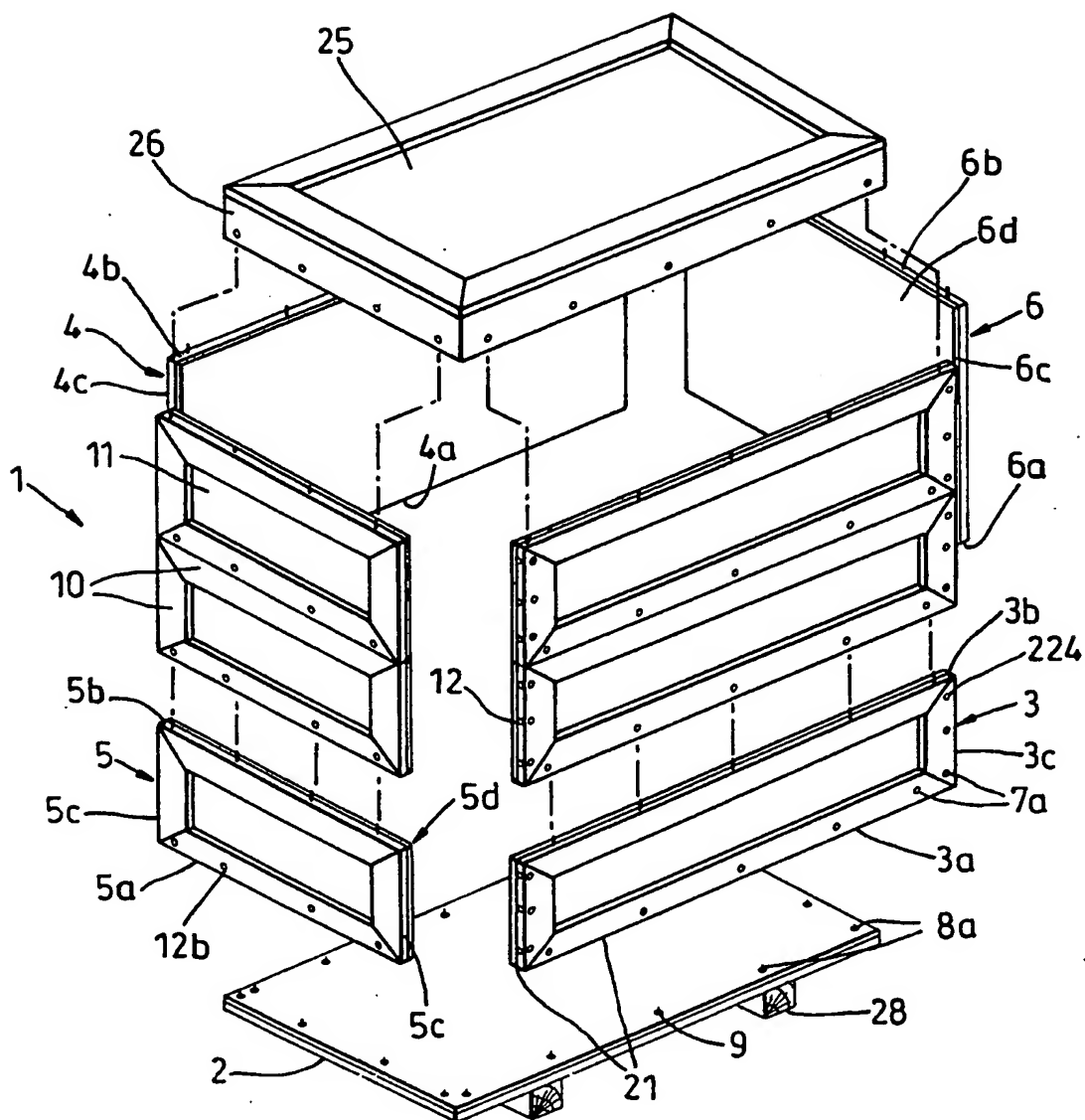
- 5 if the fastening means on the pallet comprises dowel means the dowel means has a first end for mounting on the pallet and a second end for co-operating with a cam track of a cam means mounted on a box, the second end of the dowel means being inserted into a hole in the edge of the box until the second end of the dowel means engages the cam track of  
10 the cam means mounted on the box.

57. A box according to any one of claims 32 to 56 wherein:

- the first panel comprises a recess in one face into which the cam means is inserted and a slot in the face of the panel extending from the  
15 edge of the panel to the cam track of the inserted cam means such that when the box is assembled, the second end of the dowel means mounted on the second panel is inserted into the slot on the face of the first panel and into the cam track of the cam means until the second end of the dowel means engages the cam track and rotation of the cam means causes the  
20 second end of the dowel means to be drawn further into the cam means to bring the first and second panels into close engagement and to retain the panels together.

58. A panel for a box comprising fastening means for co-operation with  
25 fastening means on further panels, the fastening means comprising cam means having a cam track for insertion in a recess on a first face of the panel and a slot in the first face of the panel extending from the edge of the panel to the recess.

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*Fig. 1*

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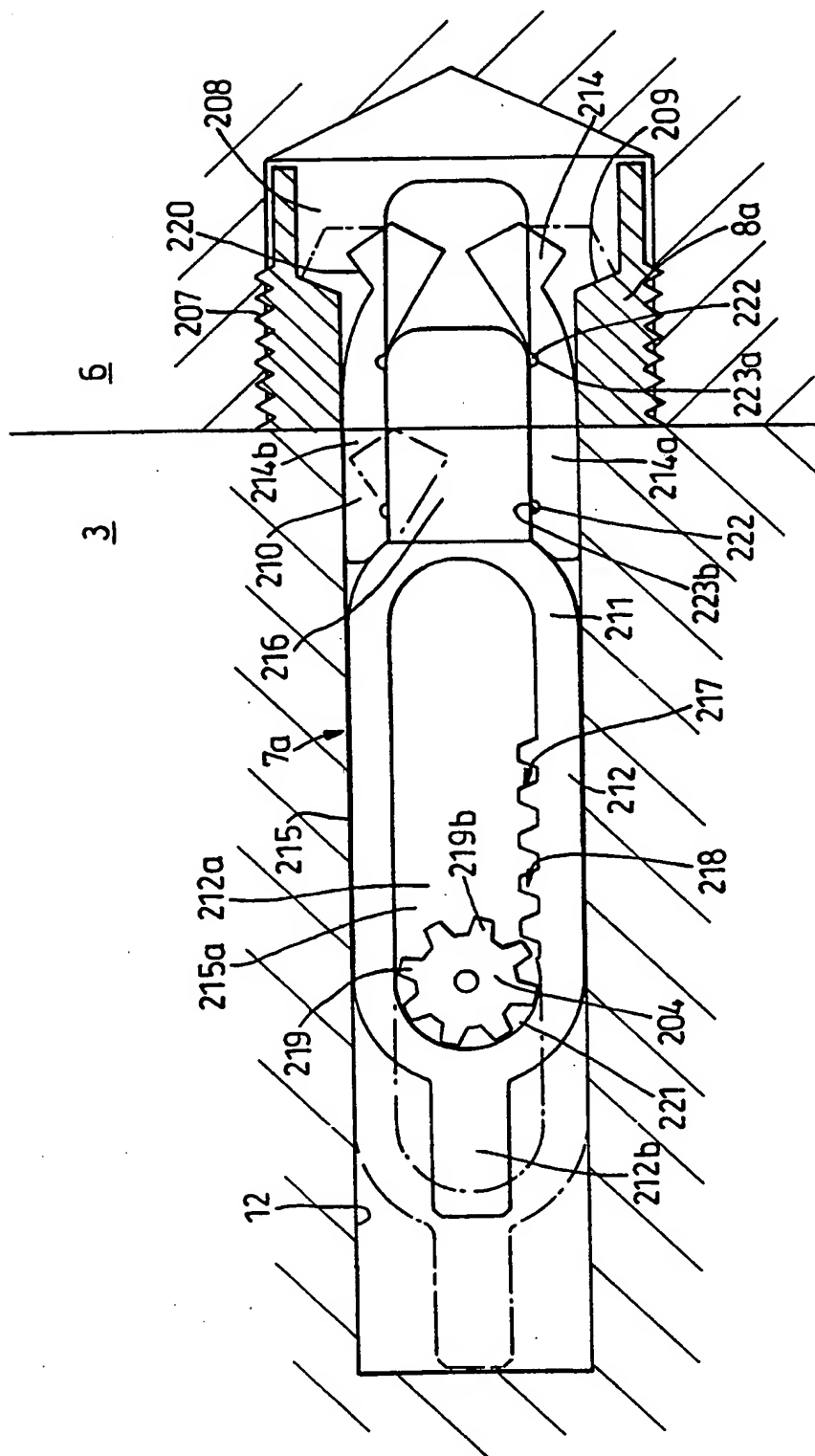
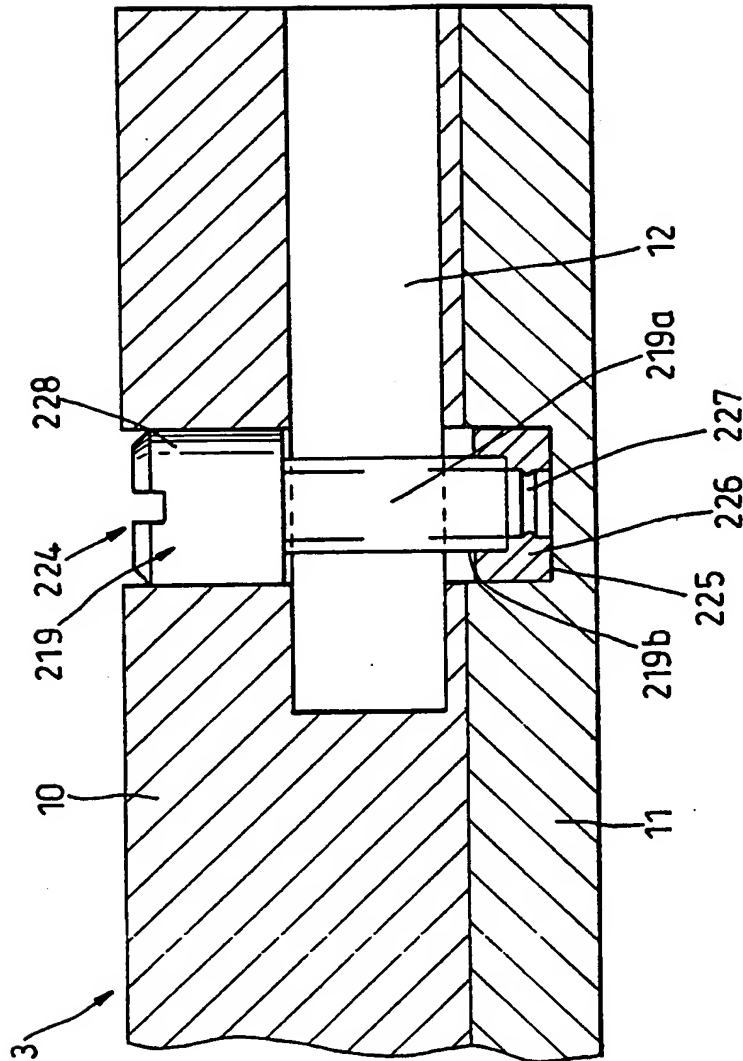


Fig. 2

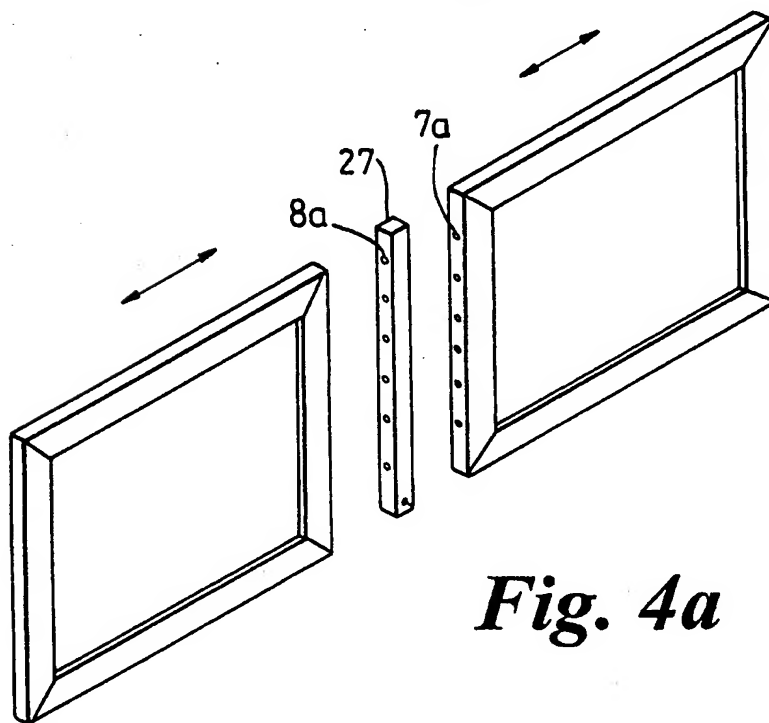
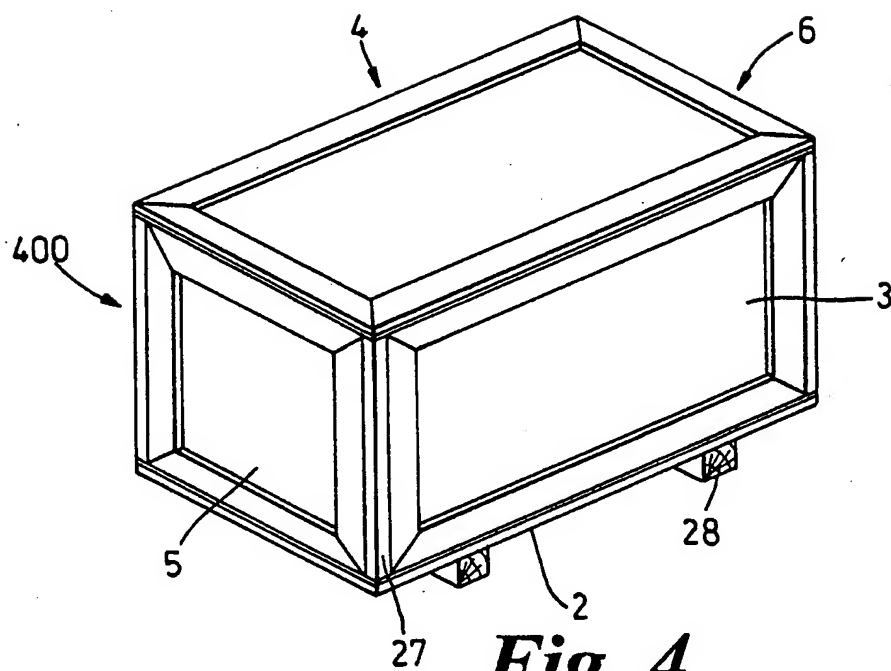
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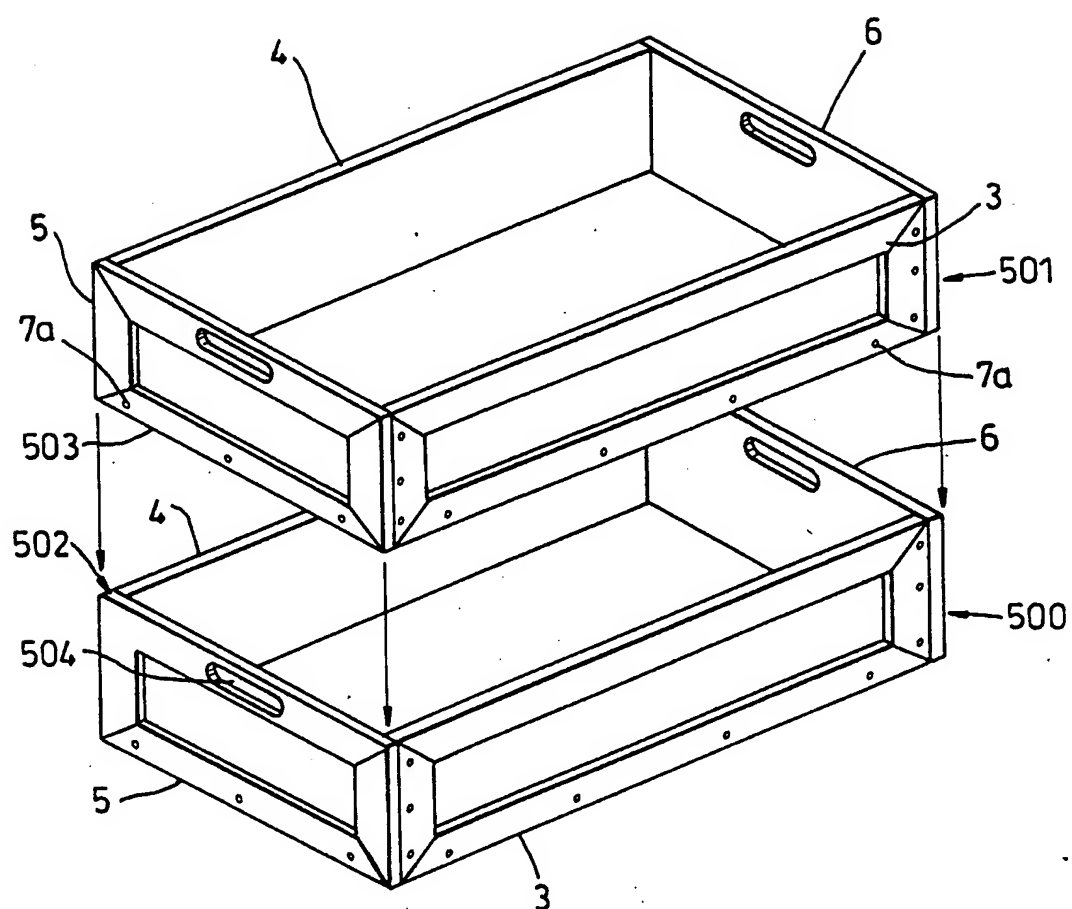
*Fig. 3*



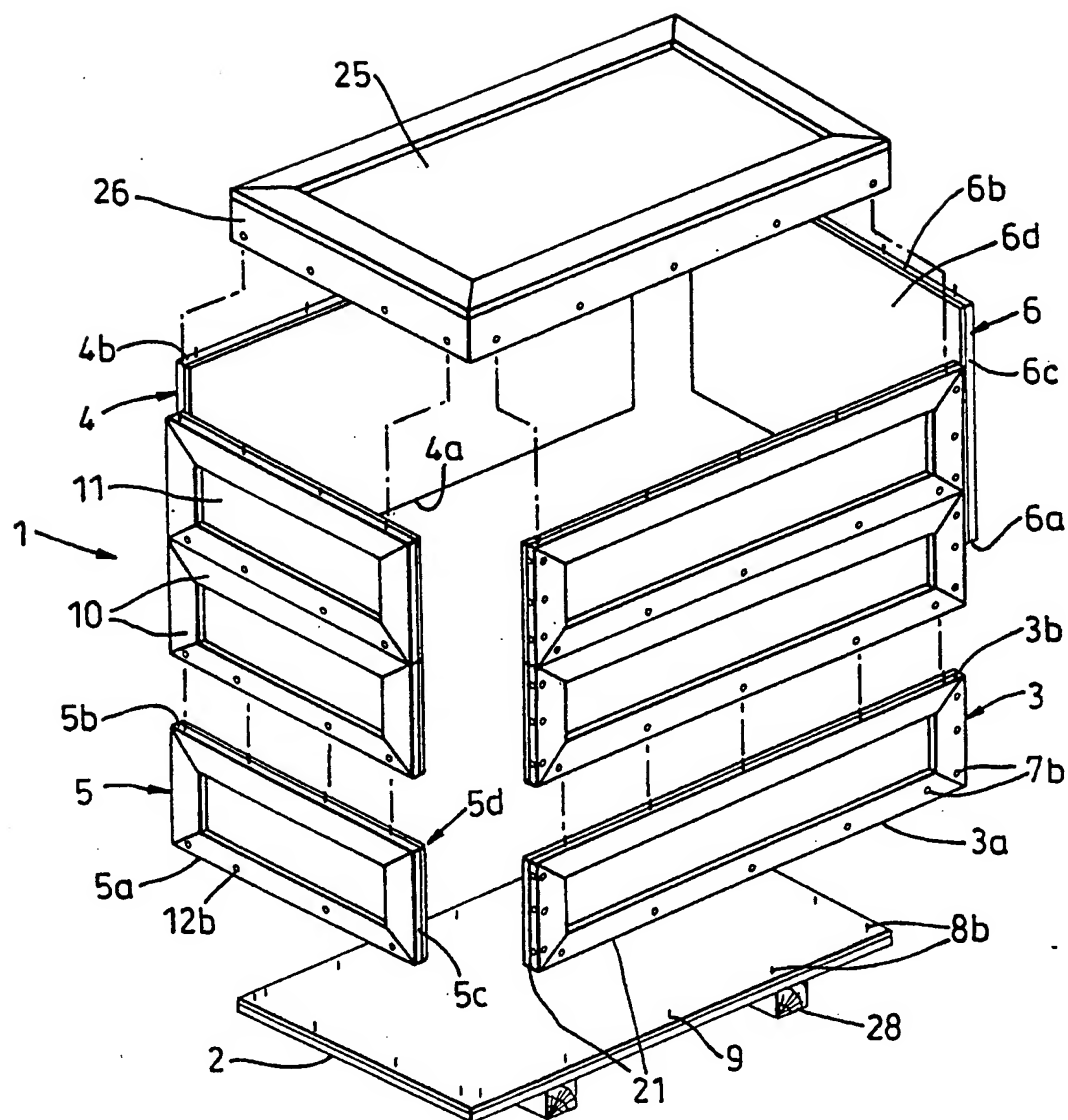
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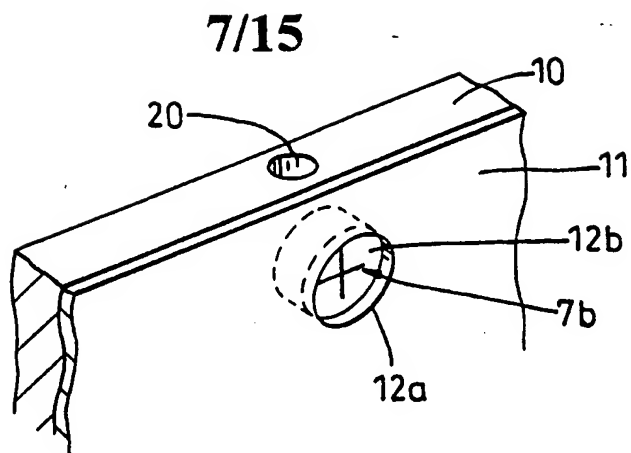
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*Fig. 5*

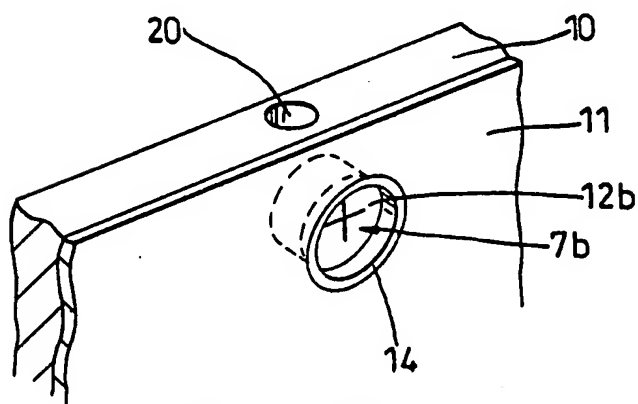
6/15

*Fig. 6*

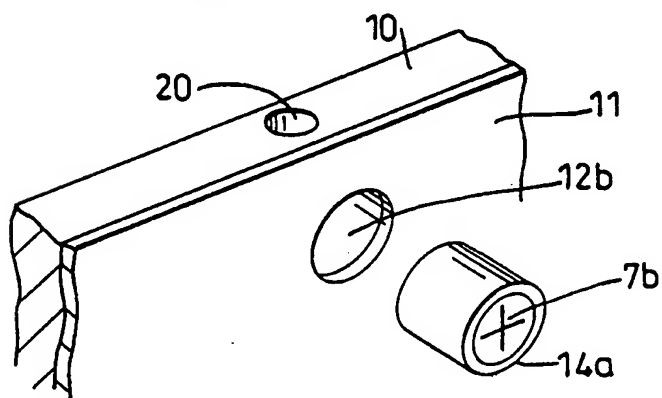
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**Fig. 7a**

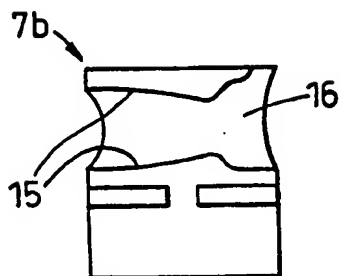


**Fig. 7b**

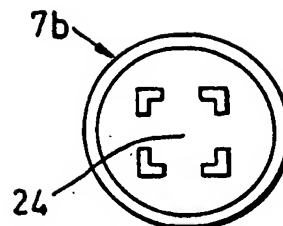


**Fig. 7c**

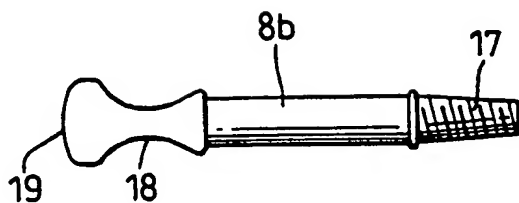
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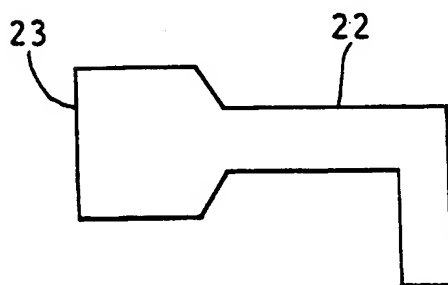
***Fig. 8a***



***Fig. 8b***

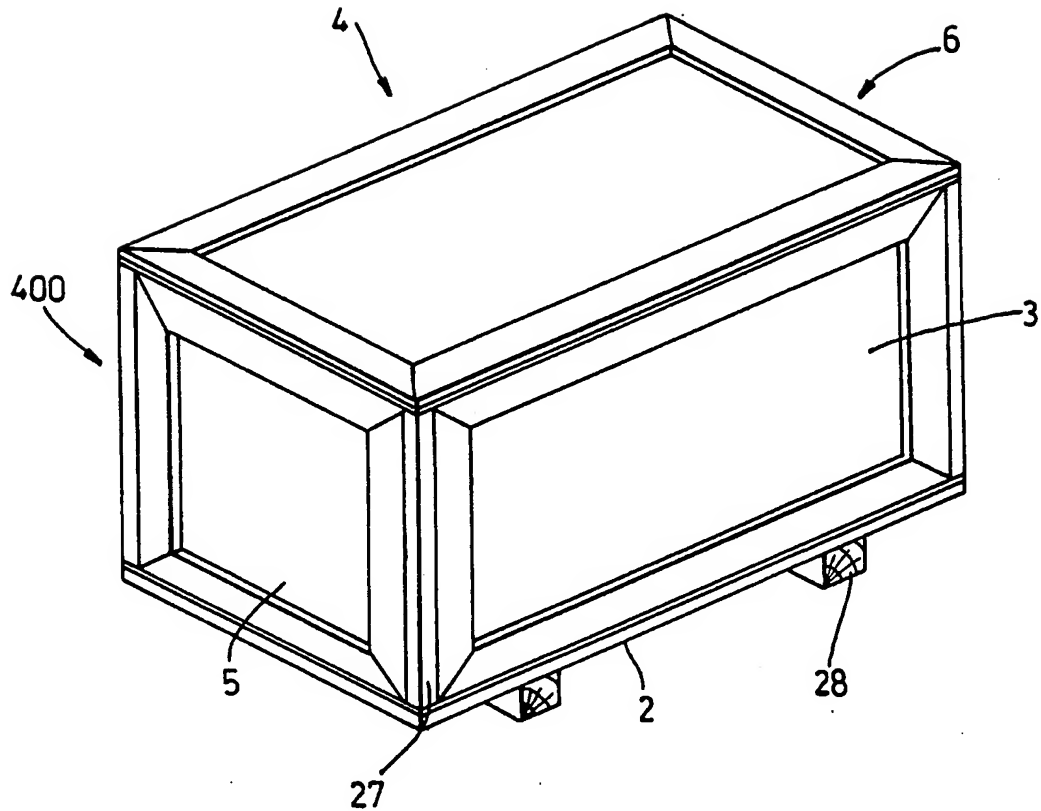


***Fig. 8c***



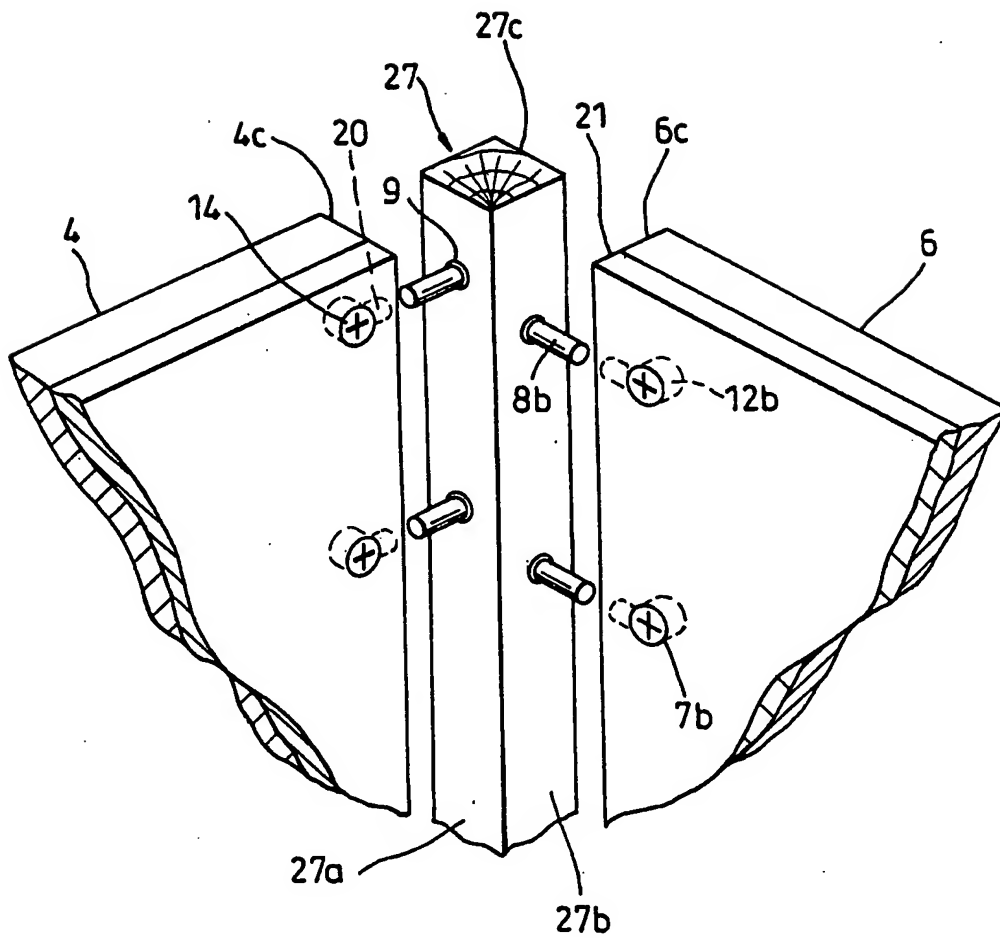
***Fig. 8d***

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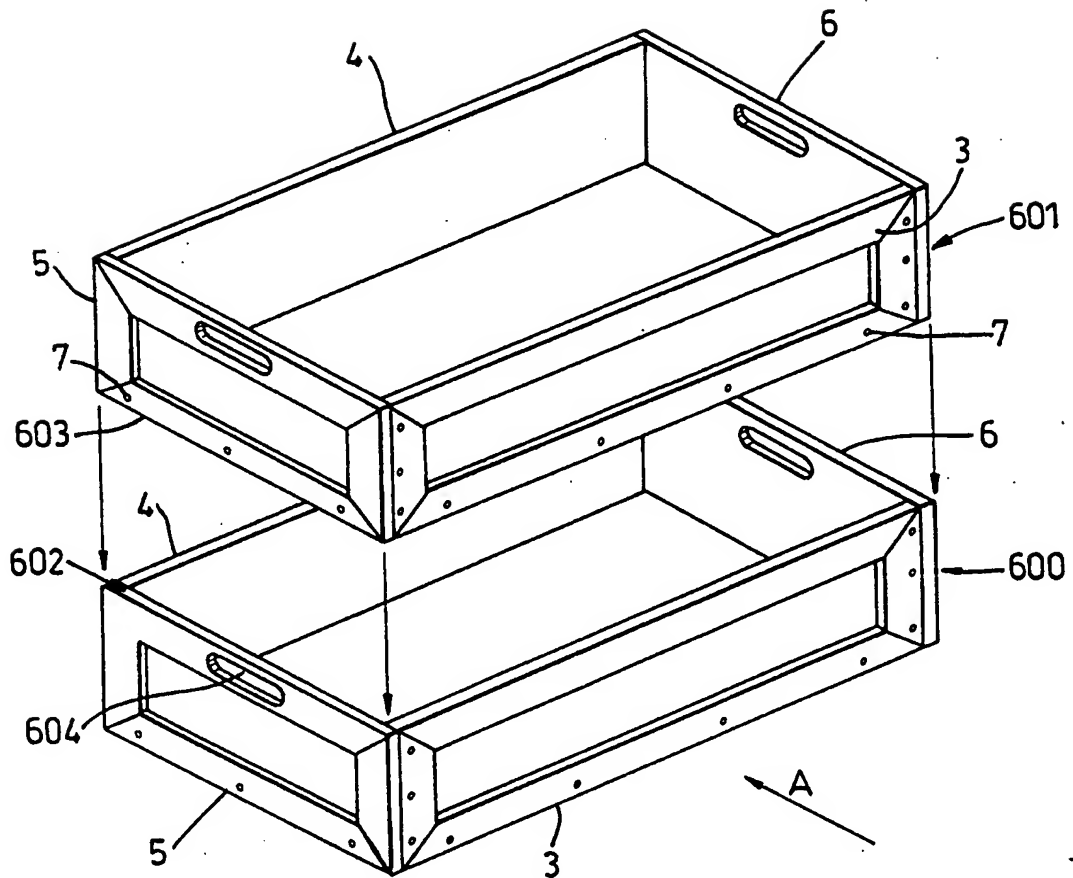
**Fig. 9**

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**Fig. 10**

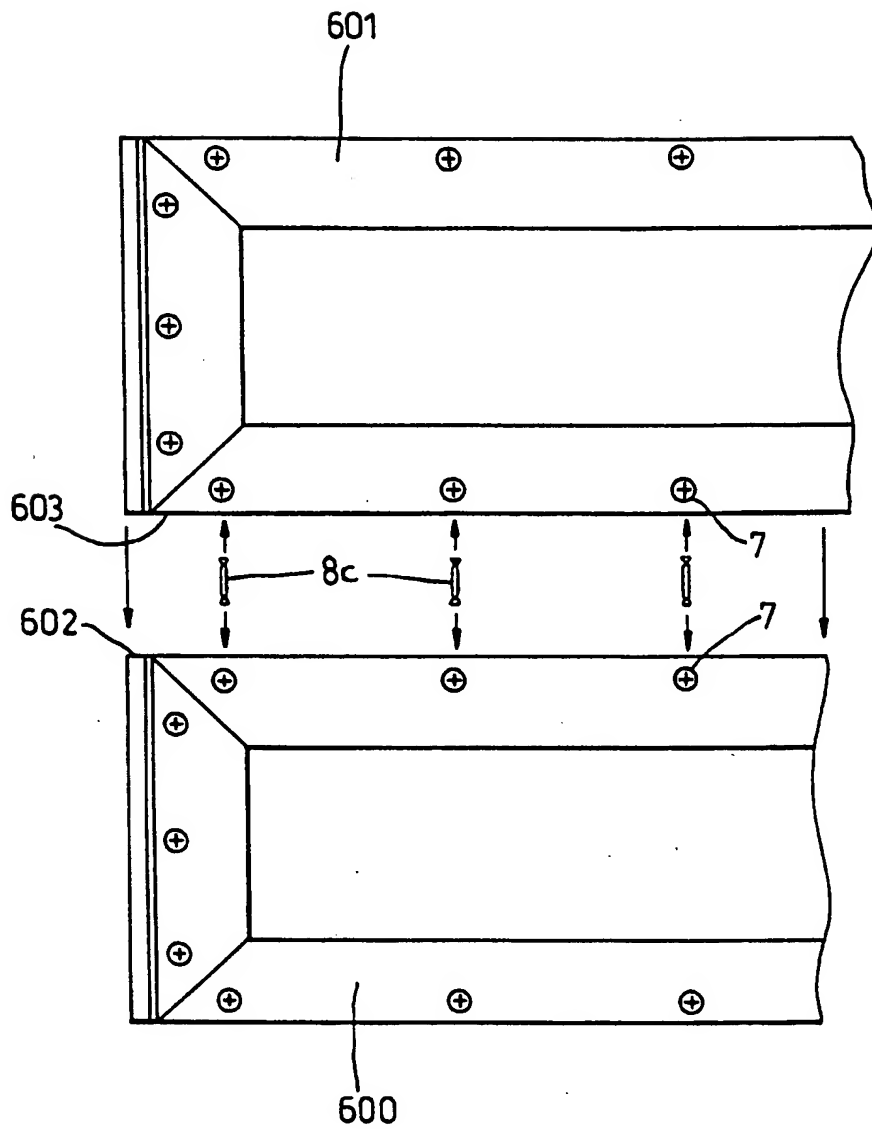
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**Fig. 11**

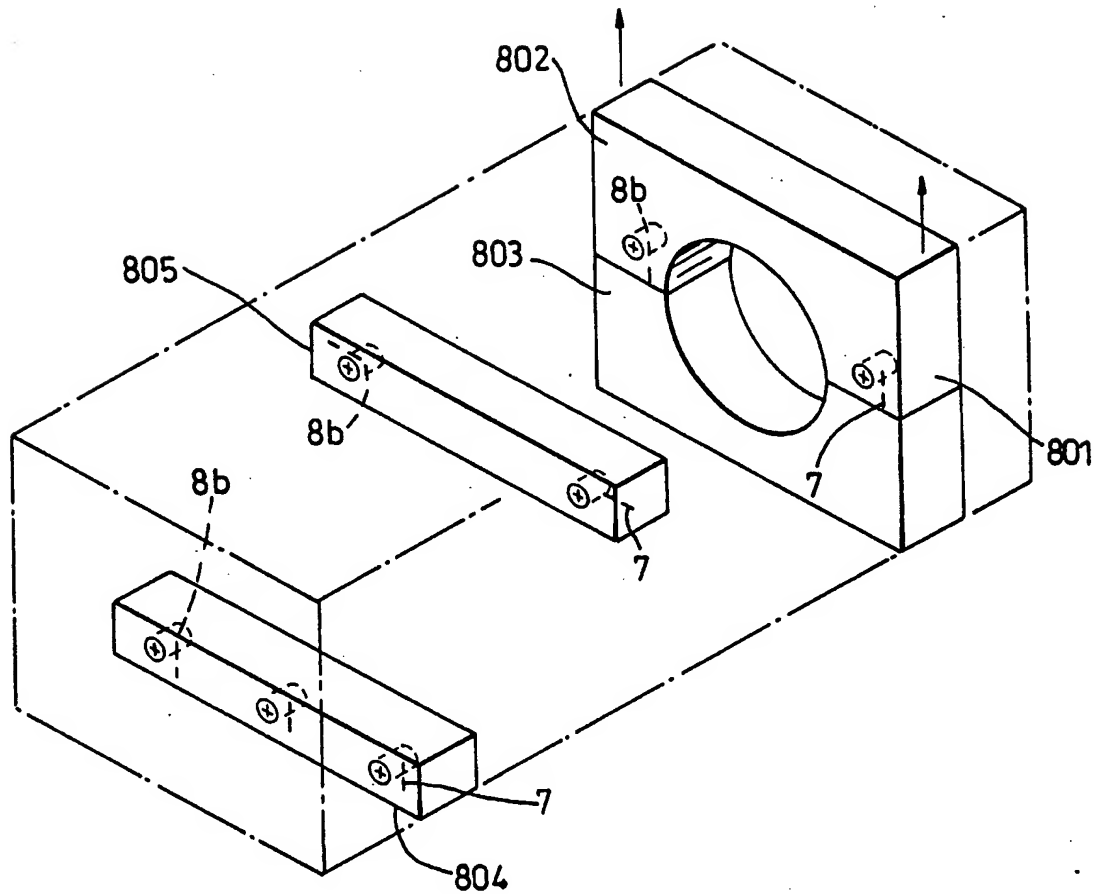


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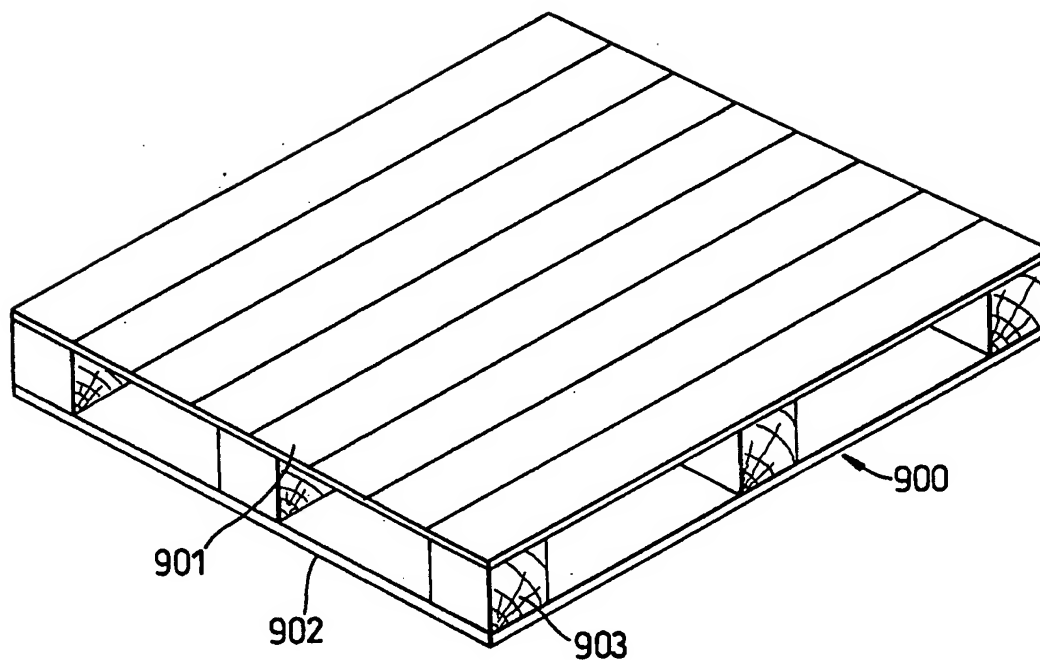


*Fig. 12*

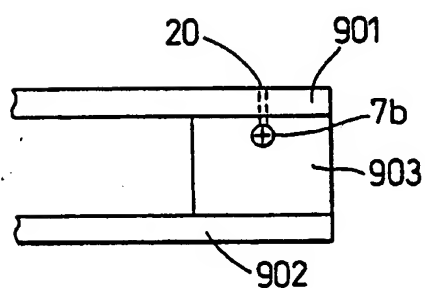
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*Fig. 13*

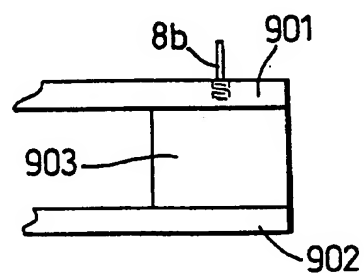
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**Fig. 14a**

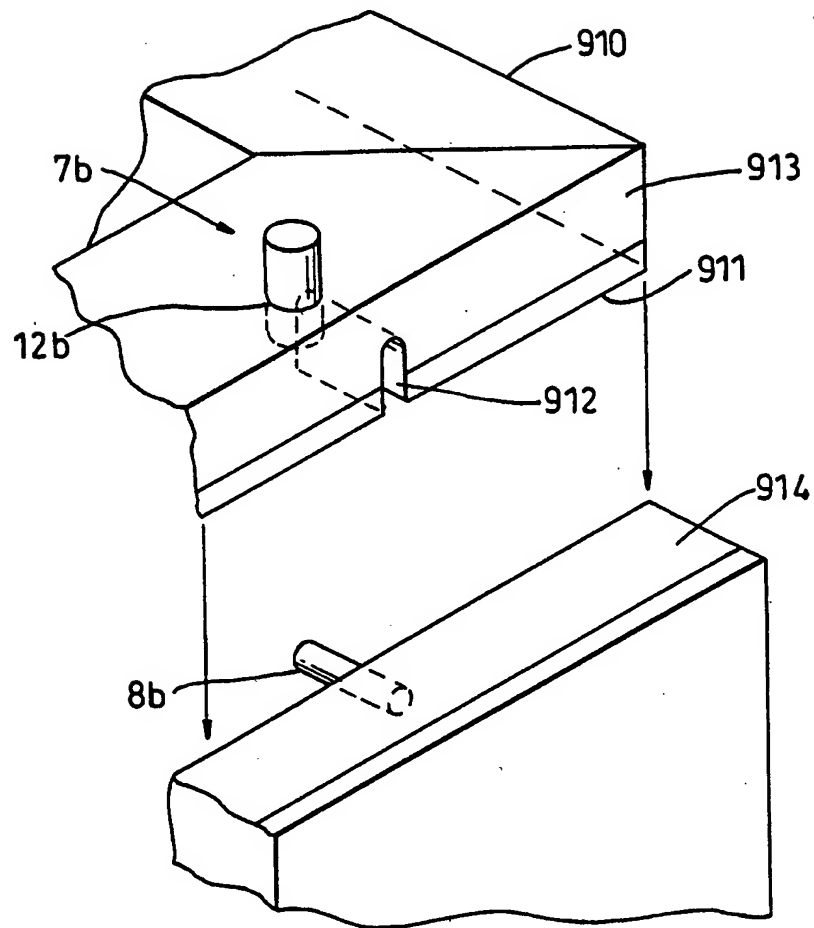


**Fig. 14b**

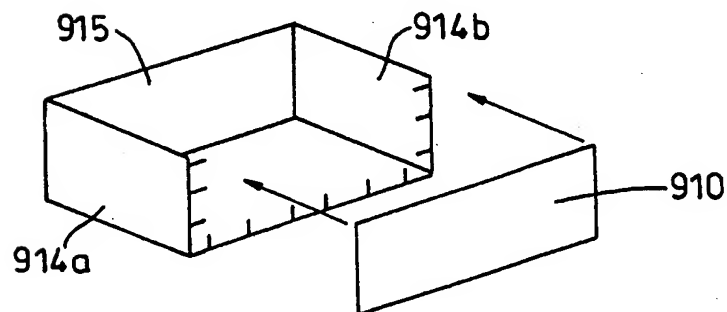


**Fig. 14c**

**15/15**



**Fig. 15**



***Fig. 15a***

# INTERNATIONAL SEARCH REPORT

International Application No

PC1/GB 99/02174

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B65D6/24 B65D6/26 E05B17/20

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B65D F16B E05B E05C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 145 666 A (NIPPON ZEON CO) 23 February 1973 (1973-02-23)  the whole document ---	1,2,29, 32,44, 54,56,58
A	US 1 478 343 A (LOONEY) 18 December 1923 (1923-12-18)  the whole document ---	1-16, 19-22, 30,58
A	GB 1 370 620 A (ARENSON A LTD) 16 October 1974 (1974-10-16) the whole document -----	19,21-25

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

### \* Special categories of cited documents:

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 "O" document referring to an oral disclosure, use, exhibition or other means  
 "P" document published prior to the international filing date but later than the priority date claimed

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 "&" document member of the same patent family

Date of the actual completion of the international search

17 November 1999

Date of mailing of the international search report

25/11/1999

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

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